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MINERALS & MINING PROGRAM

LARGE SCALE MINE PERMIT APPLICATION

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD

Contents

REGULATORY CROSS-REFERENCE

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MINERALS & MINING PROGRAM

Section I
Large Scale Permit Application Form

Loring Quarry

Department of Agriculture and Natural Resources
Minerals and Mining Program
523 East Capitol Avenue
Pierre, South Dakota 57501-3182
605 773-4201; Fax: 605 773-5286

LARGE SCALE MINING/MILLING PERMIT
Pursuant to SDCL 45-6B and ARSD 74:29

Relating to The Extraction and Processing of Minerals in Operations Affecting More Than 10 Acres and/or Removing over 25,000 Tons Per Year or For Operations Utilizing Cyanide Leaching or Other Chemical or Biological Leaching Agents

Operator's name:

Simon Contractors of SD, Inc.

General office address:

3975 Sturgis Road
Rapid City, SD 57702

Telephone: 605-394-3300

Local mailing address:

Same as above.

Telephone: Same as above.

Resident agent (if out-of-state corporation): NA

Resident agent address: NA

Resident agent telephone: NA

Legal description of affected land:

Sections 33 and 34, Township 5S, Range 4E

County:

Custer

Name and address of surface owner:

Same as Operator information above.

Name and address of mineral owner:

Same as Operator information above.

Minerals to be extracted or milled, or both:

Limestone

Proposed starting date: Activities to begin once permit is granted.

Proposed completion date: 2150

Size of area (acres) to be worked at any one time: 80
Estimated working days per year: 60-120

Estimated tons of ore per year: +/-150,000

Estimated overburden/waste tons per year: 0 - 20,000 tons. Overburden is not produced annually. See operating plan for details.

Estimated total tonnage per year: +/-165,000

Include a copy of your source of legal right to enter and initiate operations: ____ Lease ____ Letter ____ USFS Permit Deed

Include a copy of your source of legal right to dispose of tailings: ____ Lease ____ Letter ____ USFS Permit NA

INSTRUCTIONS:

Please reference SDCL 45-6B and ARSD 74:29. This large scale mining/milling permit must be accompanied by:

1. A narrative description of the methods of mining and milling to be employed per Section 6(8).
2. A reclamation plan pursuant to Section 7.
3. A map of the affected area pursuant to Section 10.
4. A fee of $1,000 payable to the Department of Agriculture and Natural Resources pursuant to Section 14. For precious metals, coal, or uranium, a fee of $50,000 payable to the Department of Agriculture and Natural Resources is required.
5. A map clearly depicting all surface and mineral owners of the affected land pursuant to Section 10 and ARSD 74:29:02:03.
6. Proof of compliance with all local and county zoning ordinance requirements pursuant to Section 4 and ARSD 74:29:02:02.

Before a hearing on this large scale mining/milling permit can be conducted by the SD Board of Minerals and Environment, the operator must submit the following:

1. Certified mail receipts confirming mailing of notice to all surface owners and lessees pursuant to Section 17.
2. A copy of the affidavit of publication of notice pursuant to Section 16.
3. Proof of filing a copy of the large scale mining/milling permit with the Register of Deeds pursuant to Section 15.
4. A surety in an amount to be determined by the department pursuant to Section 20.
5. A copy of instruments of consultation from all surface landowners, if different than the owner of the minerals, including written receipt of the operating and reclamation plans pursuant to Section 12 and 13.

Applicant affirms that the mining or milling will be conducted pursuant to SDCL 45-6B or any regulations promulgated thereunder, that he will grant access to the SD Board of Minerals and Environment or its agents to the area under this large scale mining/milling permit from the date of application and during the life of the permit as necessary to assure compliance with SDCL 45-6B.

I declare and affirm under the penalties of perjury that this claim (petition, application, information) has been examined by me, and to the best of my knowledge and belief, is in all things true and correct.

T. Scott Olsen — Date: January 4, 2022

Signature

Title: Regional Manager

STATE OF South Dakota

COUNTY OF Pennington

On this 4th day of January, 20 22, before me personally appeared

T. Scott Olsen, who acknowledged himself to be the Regional Manager (Title)

for Simon Contractors of SD, Inc. (Operator) and that he is authorized to execute the Large Scale Mining/ Milling Permit for the purposes contained therein.

Tamara C Achtien — My Commission Expires: August 5, 2022

Notary Public

SEAL

TAMARA C. ACHTIEN NOTARY PUBLIC SEAL STATE OF SOUTH DAKOTA

FOR DEPARTMENT USE ONLY

DATE APPROVED: BOND AMOUNT: PERMIT NUMBER:

Chairman, SD Board of Minerals & Environment

Section II
Legal Right to Enter

Loring Quarry

Confidential

Section III
Certification of Applicant Form

Loring Quarry

SD EForm - 2088LD V1

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MINERALS & MINING PROGRAM

STATE OF SOUTH DAKOTA

BEFORE THE SECRETARY OF

THE DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

IN THE MATTER OF THE APPLICATION OF Loring Quarry Large Scale Mine Permit Loring Quarry Large Scale Mine Permit	**CERTIFICATION OF APPLICANT**
STATE OF South Dakota South Dakota	
COUNTY OF Custer Custer	

I, T. Scott Olsen T. Scott Olsen, the applicant in the above matter after being duly sworn upon oath hereby certify the following information in regard to this application:

I have read and understand South Dakota Codified Law Section 1-40-27 which provides:

"The secretary may reject an application for any permit filed pursuant to Titles 34A or 45, including any application by any concentrated swine feeding operation for authorization to operate under a general permit, upon making a specific finding that:

(1) The applicant is unsuited or unqualified to perform the obligations of a permit holder based upon a finding that the applicant, any officer, director, partner, or resident general manager of the facility for which application has been made:

(a) Has intentionally misrepresented a material fact in applying for a permit;

(b) Has been convicted of a felony or other crime involving moral turpitude;

(c) Has habitually and intentionally violated environmental laws of any state or the United States which have caused significant and material environmental damage;

(d) Has had any permit revoked under the environmental laws of any state or the United States; or

(e) Has otherwise demonstrated through clear and convincing evidence of previous actions that the applicant lacks the necessary good character and competency to reliably carry out the obligations imposed by law upon the permit holder; or

(2) The application substantially duplicates an application by the same applicant denied within the past five years which denial has not been reversed by a court of competent jurisdiction. Nothing in this subdivision may be construed to prohibit an applicant from submitting a new application for a permit previously denied, if the new application represents a good faith attempt by the applicant to correct the deficiencies that served as the basis for the denial in the original application.

All applications filed pursuant to Titles 34A and 45 shall include a certification, sworn to under oath and signed by the applicant, that he is not disqualified by reason of this section from obtaining a permit. In the absence of evidence to the contrary, that certification shall constitute a prima facie showing of the suitability and qualification of the applicant. If at any point in the application review, recommendation or hearing process, the secretary finds the applicant has intentionally made any material misrepresentation of fact in regard to this certification,

consideration of the application may be suspended and the application may be rejected as provided for under this section.

Applications rejected pursuant to this section constitute final agency action upon that application and may be appealed to circuit court as provided for under chapter 1-26."

I certify pursuant to 1-40-27, that as an applicant, officer, director, partner, or resident general manager of the activity or facility for which the application has been made that I; a) have not intentionally misrepresented a material fact in applying for a permit; b) have not been convicted of a felony or other crime of moral turpitude; c) have not habitually and intentionally violated environmental laws of any state or the United States which have caused significant and material environmental damage; (d) have not had any permit revoked under the environmental laws of any state or the United States; or e) have not otherwise demonstrated through clear and convincing evidence of previous actions that I lack the necessary good character and competency to reliably carry out the obligations imposed by law upon me. I also certify that this application does not substantially duplicate an application by the same applicant denied within the past five years which denial has not been reversed by a court of competent jurisdiction. Further;

"I declare and affirm under the penalties of perjury that this claim (petition, application, information) has been examined by me, and to the best of my knowledge and belief, is in all things true and correct."

Dated this 4th day of January, 20 22 .

T. Scott Olsen

Applicant (print)

T. Scott Olsen

Applicant (signature)

Subscribed and sworn before me this 4th day of January, 20 22 .

Tamara C Achtien

Notary Public (signature)

My commission expires: August 5, 2023

TAMARA C. ACHTIEN NOTARY PUBLIC SEAL SOUTH DAKOTA

PLEASE ATTACH ANY ADDITIONAL INFORMATION NECESSARY TO DISCLOSE ALL FACTS AND DOCUMENTS PERTAINING TO SDCL 1-40-27 (d) (a) THROUGH (e).
ALL VIOLATIONS MUST BE DISCLOSED, BUT WILL NOT AUTOMATICALLY RESULT IN THE REJECTION OF AN APPLICATION

Section IV
Map of Affected Area

Loring Quarry

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Loring Quarry
Map of Affected Area
SDCL 45-6B-10
ARSD 74:29:02:03

0 0.1 0.2 0.4

Miles

N W E S

Scale: 1:9,000

Date Produced: 3/8/2022

Designed to be printed at 11" x 17"

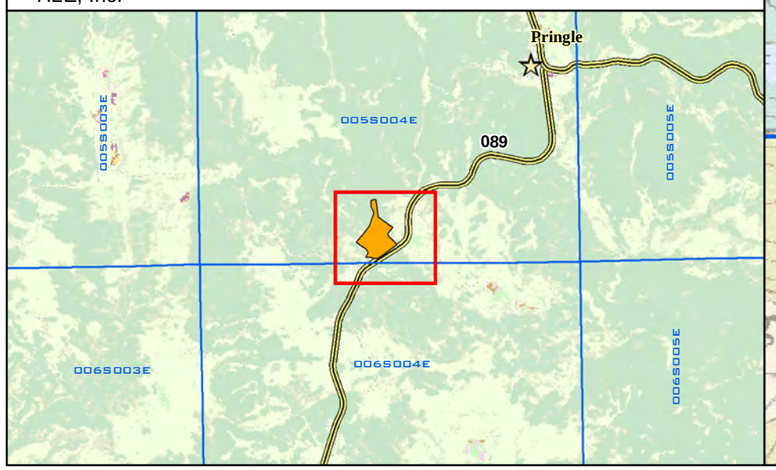
Prepared by:

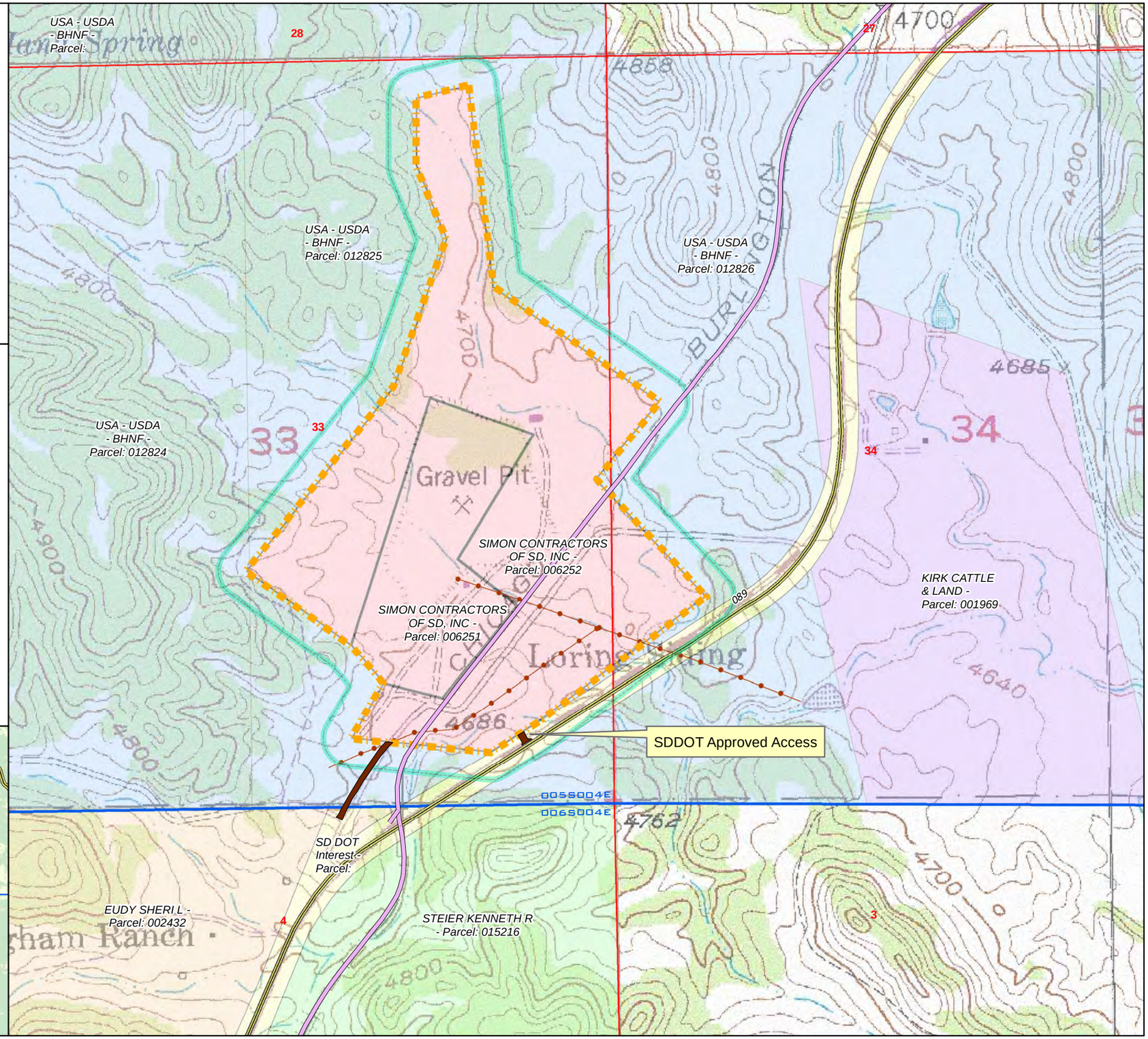
Editor: RGilson

- Mickelson Trail
- Overhead Power
- SD Highways
- Loring Quarry Property Boundary
- Access Road
- Permit Boundary 200ft Buffer
- SD Counties
- Township/Range
- Section
- EUDY SHERI L
- KIRK CATTLE & LAND
- SD DOT Interest
- SIMON CONTRACTORS OF SD, INC
- STEIER KENNETH R
- USA - USDA - BHNF

Note: Simon Contractors of SD, Inc. is the surface and mineral owner of the affected land.
Note: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land.
Note: Base map is a U.S. geological survey seven-and-one-half-minute quadrangle map in accordance with ARSD 74:29:02:12.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Permit_Parcel_v7

Section V
Wildlife Consultant Approval Letter

Loring Quarry

DEPARTMENT OF GAME, FISH, AND PARKS
Division of Wildlife – Regional Office
4130 Adventure Trail
Rapid City, South Dakota 57702-0303

July 16, 2020

ICF Jones & Stokes
ATTN. Stephanie Kane
405 W Boxelder Road, Suite A-5,
Gillette, WY 82718

Subject: Approval of ICF Jones & Stokes wildlife consultants

Dear Stephanie,

This letter represents South Dakota Department of Game, Fish and Parks approving the qualifications of the wildlife consultants, provided by ICF Jones & Stokes, conducting wildlife evaluations at the Loring Quarry Project.

Please contact me with any questions regarding this letter.

Sincerely

Stan Michals
Energy and Minerals Coordinator
Office (605) 394-2589
E-mail stan.michals@state.sd.us

cc: E. Holm (SD/DENR)

Section VI
Operating Plan

Loring Quarry

SIMON

OPERATING PLAN

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD

Table of Contents

APPENDICES

1. GENERAL DESCRIPTION

Simon Contractors of SD, Inc. (Simon) currently owns and operates the Loring Quarry under a mine license. The quarry is located approximately four miles southwest of Pringle, South Dakota in Sections 33 and 34 of Township 5S, Range 4E in Custer County. The quarry is comprised of two parcels both owned by Simon. Parcel 006251 (~45 acres) and parcel 006252 (~126 acres). Simon also owns the mineral rights. The quarry is currently accessed via County Road CS 316.

The quarry was purchased from J. Erpelding by Northwest Engineering (Hills Materials) in 1963 and was already a quarry at that time. In 2015, Simon acquired Hills Materials and has continued to operate the quarry. The quarry is an open pit limestone quarry with reserves estimated to last up to 65 years or more.

Although Simon is applying for a large scale mine permit, the actual mining operations currently conducted under the existing mine license will not change. Approval of the large scale mine permit will provide the ability to sell limestone products to an agricultural consumer base.

This mine plan was prepared and will be implemented to meet the applicable statues and regulations of SCDL 45-6B and ARSD 74:29.

2. MINING METHOD AND TYPE

ARSD 74:29:02:04, SDCL 45-6B-6(7)(8) and SDCL 45-6B-7(10)

Simon will mine limestone for commercial processing and sales by stripping the mining area of any topsoil, and/or overburden, above the limestone deposit using appropriate construction equipment such as but not limited to dozers, track excavators, scrapers, etc., depending on the layout. Typically, only enough area is stripped to allow for one to three years of sales volume. Topsoil and overburden are stockpiled or placed according to the reclamation plan. A total disturbance of approximately 62 acres is anticipated west of the George S. Michelson Trail, with the potential to disturb another 15 acres east of the trail in the long term (40 plus years out). All potential disturbance will be contained within the quarry boundary and a working/vegetative buffer, of no less than 50 ft, will be maintained from the George S. Michelson Trail.

Once topsoil and/or overburden are removed, drilling and blasting operations begin. Drilling is conducted by Simon, while blasting operations are contracted out to a third party. Blasting only occurs during production/crushing. Drilling and blasting operations will utilize a long-hole benching method. Blasting will be conducted using ammonium nitrate/fuel oil explosives detonated with a PETN (pentaerythritol tetranitrate) cast booster. Explosives are completely consumed during combustion and no residue should remain. After blasting, material is loaded into the crusher where it is sized into difference products. No tailings are produced during mining operations. The only spoil produced would be the removed overburden. At this time there are no proposed reservoirs, tailings ponds, tailings disposal sites, dams, dikes or diversion canals. There will be no tailings dams. A wash plant and washing ponds could be added in the future to remove limestone fines from specific products to meet customer specifications. Location of the wash plant and ponds would be determined at that time. Fines from the wash pond will be stockpiled for sale.

Once the material has been processed by the crusher, it is stockpiled onsite via conveyors and or loaders. There is no waste material from the crusher. Agricultural use products are of a separate, distinct specification from the construction products and will be stockpiled, sold, and tracked

separate from the construction products. When sold, the product is loaded onto trucks using a loader, weighed on a scale, ticketed, and shipped to customers. Limestone is used as a crushed stone for road base, railroad ballast, coarse aggregate in ready mix concrete, coarse and fine aggregates in hot mix asphalt, and as a component in the manufacturing of Portland cement. Limestone (ag-lime) from this mine will be sold for use in agricultural applications such as soil amendments or feed supplements. Additional limestone rock products will be used in the processing of other agricultural related products and operations.

Reclamation occurs as soon as practical after the mining process is complete. Usually overburden and topsoil are placed in their final resting place designated by the reclamation plan, and this is done where reserves have been exhausted and where it won't prohibit continued mining processes. All overburden stockpiles will be utilized during reclamation, so stockpile stability analysis will not be necessary. Once mining is complete, highwalls will be reduced to the natural angle of repose or a 3:1 slope, unless it is determined they should remain for bat habitat. Simon shall seek input from South Dakota Game, Fish and Parks regarding leaving highwalls for bat habitat. A stability analysis will be conducted should any of the highwalls remain after final reclamation.

Existing areas within the permit boundaries were historically mined by other entities prior to July 1, 1971. Disturbance was primarily within parcel 006251. These "Pre-Law" mining areas were not reclaimed, and the proposed mining and reclamation is likely to enhance the productivity of the land from its current condition.

Maps in Section VIII of the Large Scale Mine Permit Application (LSMPA) package depict pre-mining and proposed postmining topography along with four profile centerline contours. Since this is an existing quarry, true pre-mining contours only exist for the undisturbed portion of the property. Pre-mining contours from the disturbed area are from August 8, 2021, but do show contours of the unaffected portions of the area. Topography in the northeastern portion of the area will remain unchanged. Pre-mining centerline A ranges from 4609 to 4669 ft., centerline B ranges from 4608 to 4666 ft., centerline C ranges from 4597 to 4666 ft and centerline D ranges from 4586 to 4678 ft. Post-mining centerline A ranges from 4555 to 4669 ft., centerline B ranges from 4586 to 4666 ft., centerline C ranges from 4555 to 4666 ft and centerline D ranges from 4540 to 4678 ft. Quarry highwalls prior to slope reduction are depicted on the post-mining centerline contours as well. Lastly, a map showing highwall contours prior to slope reduction is included in Section VIII as well.

Depth of mining will range from 0 ft. to 100 ft. depending on depth to the limestone. Mining in 2023 will be conducted in the central part of the quarry proceeding north through 2029. Mining during this time period will primarily occur in the already disturbed area, and the stockpile area will be south of the active mining area. Mining in 2030 through 2035 will be conducted back in the central part of the quarry proceeding south through 2035. Mining in 2036 through 2042 will occur on the west side of the area in a previously undisturbed area. The stockpile area during this time period will be in area previously mined in 2023 through 2030. Mining in 2042 through 2070 will proceed down in depth rather than out. Mining on the east side of the trail will not occur until approximately 2085 or later. The direction of mining is illustrated on the mine sequence maps (LSMPA Section VIII).

The mine permit and mine license (14-977) acreages are one in the same and cannot be spatially separated. Approximately, 70% of the limestone products would be sold as construction

aggregate and 30% would go to agricultural use. Using those percentages approximately 43.4 acres west of the trail would be under the mine license and 18.6 acres would be under the mine permit. Similarly, approximately 10.7 acres east of the trail would be under the mine license and 4.3 acres would be under the mine permit.

3. LOCAL, STATE AND FEDERAL LAWS

ARSD 74:29:02:02 and SDCL 45-6B-32(1)(2)(3)(4)(5)(7)

The operating plan, reclamation plan and proposed future use is not contrary to the laws or regulations of the State of South Dakota or the United States. Simon is not currently in violation of the provisions of Chapter 45-6B with respect to other mining operations in the State. The $1,000 fee has been paid. The reclamation bond payment will be made as soon as the State deems the application complete, the bond amount is agreed upon, and before the issuance of the permit. There are no significant, valuable or permanent man-made structures located within 200 ft. of the mining operation that will be adversely affected. There are no known underground utility lines or pipelines within 200 ft. of the mining operation. The overhead power line spur west of the trail is slated to be removed and power will be provided by gen-sets. The trunk line on the east side of the trail will eventually need to be rerouted prior to be start of mining operations east of the trail. Custer County does not have any zoning, ordinances or permitting requirements that would impact a large scale mining operation. Correspondence is provided in Appendix A.

4. UNSUITABLE AND PREVIOUSLY MINED LAND

SDCL 45-6B-7(5), SDCL 45-6B-8, SDCL 45-6B-32(8), SDCL 45-6B-33(1)(3)(6) and SDCL 45-6B-92(10)

Environmental baseline surveys do not indicate that the quarry area is special, exceptional, critical or unique. The land is not ecologically fragile and can return to its former ecological role in the reasonably foreseeable future. The land does not have a unique or strong influence on the total ecosystem of which it is a part. The Department of Agriculture and Natural Resources determined the lands within the proposed Loring Quarry mine permit boundary do not constitute special, exceptional, critical or unique lands. There are no significant historic, archaeologic, geologic, scientific or recreational features at the Loring Quarry with the exception of the Mickelson Trail. A copy of the Notice of Determination can be found in Appendix B. Reclamation of the affected land is economically and physically feasible.

No adverse socioeconomic impacts were identified that would outweigh the probable beneficial impacts of the large scale mine operation. The socioeconomic study can be found in Appendix D of the Reclamation Plan.

The Loring Quarry was purchased from J. Erpelding by Northwest Engineering (Hills Materials) in 1963, and was already a quarry at that time. Simon then acquired Hills Materials in 2015, which included the Loring Quarry. Surface mining disturbance prior to July 1, 1971 was primarily within parcel 006251. Areas mined prior to July 1, 1971 have been affected under the current mine license. A map of the quarry showing the disturbed area based on aerial imagery from 1953 can be found in Section VIII of the LSMPA.

5. MINIMIZING ADVERSE IMPACTS AND CRITICAL RESOURCES

ARSD 74:29:07:02(1)(2)(7)(8)(9)(10), SDCL 45-6B-32(6), SDCL 45-6B-33(2)(3)(4)(5), SDCL 45-6B-92(1)(2)(3)(4)(5)(6)(7)(8)(9)

The mining operation is designed to minimize surface disturbance by clearing land in small sections; typically enough to allow for one to three years of sales volumes. There will be no tailings piles, and topsoil and overburden will be stockpiled for future reclamation. Stockpiles are

stored in close proximity to the disturbance to reduce haul distance. Limestone stockpiles will be located in disturbed areas reducing impacts to native areas. Topsoil and overburden are stored where they will not need to be moved until reclamation occurs. Minimizing movement will allow the stockpiles to become stabilized with vegetation reducing the chance for erosion and minimizing impacts. Crusher fines will be stockpiled for sale with the other limestone product stockpiles. Should a wash plant/ponds be constructed in the future, wash pond fines will be stockpiled for sale. These stockpiles will be watered down, which forms a crust preventing wind erosion. Reclamation occurs as soon as possible behind mining. Usually topsoil and overburden are placed in their final resting place designated by the reclamation plan, and is done where reserves have been exhausted and where it won't prohibit continued mining processes.

In general, surrounding land uses include recreation, forest and private. The quarry has been designed so that the recreational trail running through the area will not be disturbed. Private landowners and forest access will not be impacted by the continued operation of the quarry. Mining operations and reclamation will be carried out in conformance with SDCL 45-6B-35; see below for further discussion.

Water

ARSD 74:29:07:02(4), ARSD 74:29:02:11, ARSD 74:29:07:08 through ARSD 74:29:07:11, ARSD 74:29:07:27, SDCL 45-6B-41 and SDCL 45-6B-92(2)(4)

Mining operations are not expected to impact surface water, and no disturbances to the hydrologic balance are anticipated. The unnamed intermittent drainage running roughly north to south across the east side of the property as well as the unnamed intermittent drainage running west to east across the southern most corner of the property will be maintained throughout the life of the quarry and final reclamation.

The unnamed intermittent drainage in the central part quarry will not be diverted. A 1953 aerial image, provided on the Previously Mined Land map, shows that the drainage was already disturbed at that time, and was no longer hydrologically connected to the drainages east of the trail. This drainage is comprised of a small basin just to the northwest of the quarry. Given the small area of the drainage it is not expected to contribute water to the pit area regularly, and likely only flows for a brief period during intense precipitation or significant snowmelt events. Based on the National Hydrologic Dataset (NHD), it appears this drainage at one point would have crossed the railroad grade near the current scale location where there were pre-existing culverts. The vegetated swale is not a diversion ditch, but more of a product of the railroad grade. Surface water would hit the swale and break north to the unnamed intermittent drainage or south to the culverts near the scale. Surface water runoff diversions are not anticipated to be needed.

While not officially named in the NHD, the northern most drainage has generally been referred to as Cold Brook because it runs though Cold Brook Canyon further downstream. The area is also part of HUC 12 – Upper Cold Brook. A vegetative buffer will be maintained around the drainages running roughly north to south across the east side of the property as well as the unnamed intermittent drainage running west to east across the southern most corner of the property, to prevent sediment deposition, and the drainages will not be diverted.

Soil and vegetation survey results were submitted to the U.S. Army Corps of Engineers (USACE) as part of a Request for Corps Jurisdictional Determination (JD). The approved JD found that the review area was comprised entirely of dry land (i.e., there are no waters or water features, including wetlands, of any kind in the entire review area). They determined that the drainage

consisted of an upland swale, with vegetation and soil results confirming that no wetlands were present. The approved JD can be found in Reclamation Plan Appendix D.

Surface water flow was monitored (presence/absence) at the concrete culverts (see Mine Plan Map for location) after precipitation events greater than 0.25 in. Precipitation was tracked using a weather station (Meso Wet PRIS2) located in Pringle, SD. Precipitation tracking began April 27, 2020 and multiple events greater than 0.25 in. were recorded. The culvert area was consistently visited following these events and no surface water flow was ever observed. Some pooling of water did occur in a low lying area under the recreation trail. Visits were recorded and photo documented and can be found in Appendix C. Monitoring for surface flow is ongoing at this time.

Carroll Creek (an intermittent drainage) is located downstream of the quarry property boundary and is not anticipated to be impacted. The confluence of the unnamed intermittent tributaries and Carroll Creek is approximately 0.8 miles from the property boundary. There is also a permitted dam (Location Dry Draw Dam – 48844) prior to the confluence. No hydrological connectivity was ever observed while monitoring for surface water flow after precipitation events.

Mining operations are not expected to impact groundwater, and no disturbance to the hydrologic balance is anticipated. No adverse impacts to aquifer productivity, public/domestic water wells, watershed land, aquifer recharge areas or agricultural areas is anticipated. There are no direct sources of drinking water.

No well records were found within the quarry property, but an old shallow well is present in the southern part of the quarry. The windmill is no longer onsite and the well has not been pumped for several years. The functional status of the well is unknown at this time. No groundwater was encountered during exploratory drilling. A search of the SD DENR database (https://apps.sd.gov/nr68welllogs/) identified 2 wells (1 stock - 61831; and 1 domestic water well - 67605) within ½ mile of the quarry boundary; see Water Resources Map (LSMPA Section VIII). According to the well logs, the domestic well was drilled and screened to 100 ft., completed in the Minnelusa and Madison aquifers, and had a static water level of 17 ft. below land surface at the time of completion in 2008. The stock well was drilled to 170 ft., screened to 167 ft., completed in the Minnelusa aquifer, and had a static water level of 16 ft. below land surface at the time of completion in 1989. Both wells were sampled for water quality on July 21, 2020 along with a spring fed well that was identified by one of the landowners.

Upon resuming sampling in March 2021, the owner of the domestic and spring fed wells, requested the domestic well be sampled from a different tap. From March through August this tap was sampled assuming it was drawing from the domestic well. Unfortunately, while going through the process of listing and selling the property the owner discovered that the tap was actually connected to the spring-fed well. The September, October and November samples were collected from the original location sampled July 21, 2020, which is drawing from the domestic well. The owner of the stock well declined to allow continued sampling. Results from groundwater monitoring are provided in Appendix D.

Groundwater was not encountered during exploratory drilling. The Loring Quarry is located on an outcrop of Madison limestone. The quarry is also near outcrops of the overlying Minnelusa formation and includes some alluvial deposits along the unnamed intermittent drainages. The Pahasapa Limestone and upper Englewood Limestones form the Madison group, but the quarry area is comprised entirely of Pahasapa Limestone. Overburden within the quarry area ranges

from 0 to 50 ft. with the thickest areas of overburden occurring outside the Proposed Permitted Affected Area. The bottom of the limestone deposit was not encountered during exploratory drilling, and limestone thickness could exceed 200 ft. A USGS geological map by Redden and Dewitt (2008) showing the geology, structure and geophysics of the Central Black Hills, South Dakota, indicates the quarry is characterized by a small-scale ellipsoid-shaped domal geologic structure likely formed by the fractureless upwarping of the limestone. The apex of the dome is in the current quarry area and the plunging anticline limbs of the dome are asymmetrical with the longest limbs orientated northwest and southeast and the shortest limbs oriented northeast and southwest. Cross sections of the geology near the quarry were created from the geological map by Redden and DeWitt (2008) and are in Section VIII of the LSMPA.

Generally, groundwater flow in the Madison is radially outward from the core of the Black Hills. The shallow Pahasapa Limestone in the quarry area is largely unsaturated and potentiometric maps of the Madison aquifer do not include the quarry area. However, the assumed direction of groundwater flow in the Madison aquifer near the quarry is shown on the geological cross sections (LSMPA Section VIII). Groundwater flow in the Minnelusa aquifer also regionally occurs radially outward from the core of the Black Hills. A modified potentiometric map of the Minnelusa aquifer (Strobel, et. al., 2000; sheet 2) and assumed groundwater flow near the quarry can be found in LSMPA Section VIII. Locally, the direction of groundwater flow in the Minnelusa aquifer varies, but likely is influenced by land-surface topography because the aquifer is largely unconfined in the area near the quarry. The quarry itself contains very little Minnelusa formation, but nearby wells are fully or partly completed in the Minnelusa formation. Both the Madison and Minnelusa aquifers recharge from precipitation infiltrating at outcrops. The area receives an average of 19.0 inches of annual precipitation and has an average annual snowfall of 56.0 inches.

The domestic well (67605) completion report from the driller's log states it was drilled into red shale and limestone, and screened from 30 to 100 ft. Although possibly partly completed in the Madison aquifer, the primary sources of recharge to the well likely are the Minnelusa outcrops near the well. The well is in a valley with rising topography about 200 meters to the north and south (see geological cross section A to A') indicating that recharge to the well is from the watershed bounded by the high terrain surrounding the well. The recharge area for this well, as well as the spring, likely is outside the quarry property. Similarly, the stock well (61831) was completed in the Minnelusa formation, and is also in a valley with high topography about 500 meters to the east and west (see geological cross section B to B'). The likely sources of recharge to this well is the watershed bounded by the high topography which is also outside the quarry property. Quarry expansion in the Pahasapa Limestone has a very low likelihood of affecting recharge sources for the domestic well, spring or stock well.

Because the quarry is on the apex of a domal structure with anticlines dipping away from the center of the quarry, the Pahasapa Limestone would require saturation to a high elevation to permit groundwater flow into the quarry. Groundwater has not been encountered during current mining operations, and there is anecdotal evidence that the grotto under the quarry is dry.

Areas of karst terrain in the Minnelusa and Pahasapa Formations are common in the Black Hills of South Dakota. Karst terrains include geologic features such as barren rocky ground, caves, sinkholes, underground cave lakes, and the absence of surface streams and lakes (Langer, 2001). These karst features form from groundwater dissolving soluble limestone. Most karst developments in the Pahasapa are in the upper half to upper two-thirds of the formation thickness and generally are close to the contact with the Minnelusa Formation. Karst features

provide conduits for rapid recharge to aquifers and enable the fast flow of groundwater through aquifers. Additionally, karst developments have low self-purification capabilities for groundwater. Best management practices are in place to minimize and/or eliminate the possibility of impacting the Madison aquifer via surface inflow into the quarry area. These practices include not storing bulk fuel or oil on location, following best-management practices for herbicide application, use of water for dust control only, and adherence to a storm water pollution prevention plan. Each of these measures are described in further detail below.

A Spill Prevention Control and Countermeasure (SPCC) Plan is not required for this mining operation as there is less than 1,320 gallons of bulk storage on location. Equipment is refueled using mobile refuelers, which are not parked or stored on location. Refueling operations are manned ensuring timely clean-up of any spills should they occur.

The only use of chemicals onsite would be herbicides for noxious weed control and potentially soil amendments, if required during reclamation. Herbicides will be applied on an as needed basis by a licensed and reputable third party contractor following all applicable regulations and best management practices.

The mining operation anticipates only requiring the use of water for dust control. Approximately 6,000 gallons per 10 hour day are used to control dust at the crusher drop points. Dust palliatives will be used to control dust as needed and to conserve water. Water is sourced from Hot Springs and a water rights permit will not be required at this time. No ponds, dams or pollution control facilities will be required.

The Loring Quarry is currently covered under South Dakota's General Permit for Storm Water Discharges Associated with Industrial Activities (Permit No. SDR00A294). A Storm Water Pollution Prevention Plan (SWPPP) has been prepared for mining activities as is required for coverage under the general permit to discharge. The SWPPP is included in Appendix E of the Operating Plan. The SWPPP lists Best Management Practices (BMP's) that Simon will utilize to prevent potential adverse impacts to the hydrologic features described above. As part of the monthly storm water inspections, drainages at the quarry will be monitored to ensure no sediment deposition has occurred. All reclaimed areas will be inspected for erosion and revegetation issues in order to comply with the terms and conditions of the mine permit. Inspections will also be conducted should a precipitation event of 1.0 inch or more occur. Precipitation events will be monitored using the same weather station described above. No other surface water monitoring is planned at this time.

Given that no groundwater has been encountered at the quarry, groundwater quality sampling results all met drinking water standards, and that no complaints regarding water quality have been received, additional groundwater sampling is not planned at this time. It is not anticipated that groundwater will be encountered when mining begins in the east expansion area; however, should groundwater be encountered a groundwater discharge plan will be prepared pursuant to ARSD 74:54:02 and submitted 180 days prior to any discharge.

Soils

SDCL 45-6B-92(6)

Pits/quarry and Rapidcreek cobbly loam comprised the majority of the project area, and these soil map units are not considered to be unusual or unique although moderate to high erosion hazards require best management practices during reclamation and revegetation. These measures include

surface roughening initially, followed by seeding for stabilization. Refer to the Reclamation Plan for the seed mix and specifics regarding topsoil salvage.

Map units with rock outcropping (Q0659E Rockerville-Rock outcrop complex, 6 to 30 percent slopes and Q0702F pits/quarry) were noted to have low revegetation potential due to the lack of available topsoil salvage. Although topsoil salvage in these areas is lacking, there will be adequate topsoil for reclamation from other areas of the quarry. See Section 6 of the Reclamation Plan for a detailed discussion of topsoil salvage.

Noise

SDCL 45-6B-92(9)

Nearby residences, State Highway 89 and the Mickelson Trail could be impacted by noise. Mitigation efforts are in place to eliminate and/or reduce noise in areas surrounding the quarry. Blasting will not occur on low overcast days to minimize reflection of noise and air blast back to the ground. Blasting will be monitored as necessary with a seismograph to measure, record and document ground accelerations to ensure blasts are below standard thresholds to prevent any property damage to adjacent landowners (see Viewshed map for residence locations in LSMPA Section VIII).

Air Quality

SDCL 45-6B-92(8)

Nearby residences, State Highway 89 and the Mickelson Trail could all be impacted by fugitive dust depending on wind direction and speed. Dust mitigation includes watering the highwall face and pit floor prior to blasting and watering the muck pile after detonation of the shot. The portable crusher has an onboard water dust suppression system to control airborne particulates.

Visual Resources

ARSD 74:29:07:02(3)

Some quarry activities are visible to occasional motorists traveling on State Highway 89, just east of the property boundary. The quarry has been in existence since the 1950's and should not have any new impact on the scenic nature of the area. The viewshed from nearby residences should not be impacted by continued mining based on viewshed modeling (LSMPA Section VIII). The need for visual screening is not anticipated.

Access

ARSD 74:29:07:02(5), ARSD 74:29:07:12(1)(2)(3)(4)(5)(6)(7)(8)(9)(10)

Access to and from the quarry is already established (west of the trail) and no new haul roads will be constructed and no roads cross the trail. This access is off of 18 Mile Road (County Road 316) and crosses a small portion of US Forest Service. This road is outside the DOT right-of-way, on Simon property, and is not within a riparian area and does not cross any streams. This road may be used by cavers to access the grotto, Black Hills Power or a rancher should grazing be occurring. This access will be maintained during the mining operation. The quarry property is fenced and access is limited by a locked gate.

Access to the east side of the quarry will be from a SD Department of Transportation approved access off Highway 89 that is already in place. A drainage crossing will be installed using either culverts or a concrete slab bridge; see Mine Plan Map for location. The drainage will be crossed at a right angle and be protected from erosion using appropriate methods depending on the type

of crossing. Should a culvert crossing be used, it will be maintained to prevent erosion at the inlet/outlet, and avoid plugging or collapsing. This crossing will be removed during reclamation.

Vegetation

SDCL 45-6B-92(3)

The project area is already an operating quarry with some forested rangeland pasture. No threatened and endangered or SD Natural Heritage vegetative species were identified during the baseline vegetative survey. This area is similar to surrounding lands and does not exhibit unique scenic or aesthetic qualities.

Cultural and Wildlife

ARSD 74:29:07:02(6)

Baseline surveys and onsite visits conducted at the quarry resulted in the identification of two critical resources, as defined in SDCL 45-6B-2. Approximately 0.4 miles of the George S. Mickelson Trail crosses the eastern side of the property. This was identified as a critical resource and as such precautions will be taken so as not to disturb the trail. A 50 ft buffer will be maintained between mining operations and the trail at all times. No access roads will cross the trail. Access to the east side of the quarry will be from a SD Department of Transportation approved access off Highway 89 that is already in place. No other sites were recommended as eligible for the National Register of Historic Places.

Bats were the second critical resource identified and included four SDNHP sensitive bat species (Townsend's big-eared bat, silver-haired bat, long-eared myotic and fringe-tailed bat) and associated highwall habitat. Bat species were identified acoustically during spring and fall surveys. The grotto located beneath the quarry pit, and associated entrances, were evaluated as potential bat hibernaculum habitat. Two rounds of surveys were conducted at this location and no bats were observed emerging from either the highwall or nearby man-made (capped) grotto entrances. It is likely species recorded during the surveys were using the area for foraging, as there is suitable roost and hibernacula habitat present beyond the quarry property.

While there was no indication that bats were using the grotto and associated entrances during the hibernaculum surveys, mitigation efforts will be employed during the roosting and hibernation periods to minimize adverse impacts to this critical resource. Mitigation measures will include:

- Seasonal restriction on tree cutting, and
- Seasonal restriction on blasting near the vuggy highwall and pit area with grotto entrances.

To avoid or minimize disturbance to roosting bats, tree removal (live or dead) will only occur between September 15th and May 15th. Ongoing mining activity will likely preclude bats from using the vuggy highwall for roosting habitat. Bats utilizing the vuggy highwall will be displaced by mining operations such as drilling and blasting.

To avoid and/or minimize impacts to hibernating bats using the vuggy highwall and main pit area (with grotto entrances) blasting in this area may be restricted. If mining in this area has not occurred during the preceding month(s), blasting may not begin between October 1st and March 15th. If blasting at the vuggy highwalls has been continual throughout the summer, it can continue into November. The continued disturbance and disrupted highwalls should minimize impacts to bats by discouraging use of the area for hibernation. Blasting into October and/or November is

not a common occurrence, but is needed occasionally. To preclude bats from accessing the grotto, the manmade entrances are and will remain covered.

No significant impacts to other wildlife species are anticipated from continued mining and reclamation activities at the quarry. The quarry was not identified as critical deer winter range, and no coldwater fisheries exist on the property. No threatened or endangered wildlife species depend on the biological productivity of the land, and the majority of habitats found within the quarry boundaries are typical of the region, and no unique or unusual wildlife features are present. Activities that could cause impacts to wildlife have been present, continuous and ongoing for several decades.

6. REFERENCES

Langer, William H. 2001. U.S. Geological Survey Open-File Report OF-01-0484. https://pubs.usgs.gov/of/2001/ofr-01-0484/ofr-01-0484po.pdf

Redden and DeWitt. 2008. Maps Showing Geology, Structure, and Geophysics of the Central Black Hills, South Dakota; sheet 1. https://pubs.usgs.gov/sim/2777/downloads/2777_sheet1.pdf

Strobel et. al., 2000. Potentiometric Surface of the Minnelusa Aquifer in the Black Hills Area, South Dakota.; sheet 2. https://pubs.usgs.gov/ha/ha745c/ha745cSheet2.pdf

Appendix A:

Custer County Zoning Communication

From:	Terri Kester
To:	Becky Morris
Subject:	FW: Custer County Ordinances for Limestone Mining
Date:	Thursday, February 6, 2020 4:32:00 PM
Attachments:	image001.png

Terri Kester

From: James Kor
Sent: Thursday, February 06, 2020 4:00 PM
To: Bmorris@h2eincorpotrated.com
Subject: RE: Custer County Ordinances for Limestone Mining

Becky,

Custer County does not have any zoning, ordinances or permitting requirements that would impact a Large Scale Mining operation. We do not foresee the County having any opposition to the permit.

Jim Kor, PE

Staff Engineer

Custer County Planning Department

From: Becky Morris <BMorris@h2eincorporated.com>
Date: February 6, 2020 at 2:27:17 PM MST
To: Kimberly Kerkvliet <kkerkvliet@custercountysd.com>
Subject: Custer County Ordinances for Limestone Mining

> Hello Kimberly-
>
> Hi my name is Becky Morris with H2E, Inc. I am helping Simon prepare a Large Scale Mine Permit application for submission to SD DENR. Simon currently operates the Loring Quarry (limestone) under a mine license, but due to changes in the operation will need to apply for a Large Scale Mine Permit. As part of the mine permit application, the SD DENR wants to know that the company applying for the mining permit is complying with any county zoning, ordinances and permitting requirements the county may have.
>
> Does Custer County have any zoning, ordinances or permitting requirements that

would impact a limestone quarry?

Please respond in writing so that I may include the response in the permit application.

Thank you for your time!
Becky

Becky Morris, Ph.D.
Environmental Scientist
H2E, Inc.
801 East 4th Street, Suite 5
Gillette, WY 82716
Cell: 307-696-7007
bmorris@h2eincorporated.com

Appendix B:

Department of Agriculture and Natural Resources Notice of Determination

DEPARTMENT of AGRICULTURE and NATURAL RESOURCES
JOE FOSS BUILDING
523 E CAPITOL AVE
PIERRE SD 57501-3182
danr.sd.gov

NOTICE OF DETERMINATION OF SPECIAL, EXCEPTIONAL, CRITICAL, OR UNIQUE LANDS SIMON CONTRACTORS OF SD, INC.

The Department of Agriculture and Natural Resources has made its determination regarding a Notice of Intent to Operate and Request for Determination of Special, Exceptional, Critical, or Unique Lands from Simon Contractors of SD, Inc., 3975 Sturgis Road, Rapid City, South Dakota 57702. The Notice of Intent to Operate was submitted as required under ARSD 74:29:10 for purposes of requesting the department to determine whether the lands potentially affected by the mining operation are eligible for inclusion on the preliminary list of special, exceptional, critical, or unique lands.

The proposed operation involves the expansion of the Loring Limestone Quarry located approximately four miles southwest of Pringle, South Dakota which is currently mined under Simon Contractors' mine license. The mine permit will allow Simon Contractors to mine limestone for uses other than construction aggregate and cement, such as agricultural applications, including, but not limited to feed and soil supplements and food processing. Topsoil and overburden will be stripped from portions of the expansion area every one to three years to match production. The stripped area will be drilled and blasted, and limestone will be removed and hauled to an on-site crusher where it will be sized into different products. After the limestone is processed, it will be stockpiled until it is loaded onto trucks and shipped to customers. Reclamation will occur concurrently with the mining operation.

In accordance with ARSD 74:29:10:08 and 74:29:10:09, the department has determined that the lands described in the Notice of Intent to Operate do not constitute special, exceptional, critical, or unique lands. This determination is based on the on-site inspection of the proposed lands to be affected, examination of the established preliminary list, consultation with other agencies, and evaluating information provided with the Notice of Intent to Operate. In addition, no nominating petitions pertaining to the lands described in the Notice of Intent were filed with the department.

The lands described in the Notice of Intent to Operate are considered cleared from special, exceptional, critical, or unique characteristics in accordance with ARSD 74:29:10:15. This clearance will remain in effect for seven years. If a mine permit application is not submitted within the seven-year period, the Board of Minerals and Environment may declare the clearance void and the lands may be reevaluated.

Simon Contractors of SD, Inc. may appeal the department's determination by filing a petition for a contested case hearing pursuant to SDCL 1:26 within seven days after receipt of the determination. The hearing on the appeal shall be confined to the determination of the lands as special exceptional, critical, or unique and whether an environmental impact statement and socioeconomic study will be required.

Persons desiring further information may contact Eric Holm, Minerals and Mining Program, at (605) 773-4201.

Hunter Roberts
Secretary
Department of Agriculture and Natural Resources

July 14, 2021

Appendix C:

Surface Water Monitoring Photo Log

	
5/12/2020 Event on 5/11/2020 (0.26 in.)	5/12/2020

	
5/13/2020 Event on 5/13/2020 (0.39 in.)	5/13/2020

5/21/2020
Event on 5/20/2020 (0.32 in.)

5/21/2020

	
6/1/2020 Event on 5/20/2020 (0.72 in.)	6/1/2020

6/8/2020
Event on 6/6/2020 (0.36 in.)

6/8/2020

7/6/2020
Event on 7/5/2020 (1.38 in.)

7/6/2020

	
7/16/2020 Event on 7/15/2020 (1.16 in.)	7/16/2020

	
7/30/2020 Event on 7/29/2020 (0.75 in.)	7/30/2020

	
10/21/2020 Event on 10/20/2020 (0.39 in.)	10/21/2020

	
5/3/2021 Event on 5/2/2021 (0.72 in.)	5/3/2021

	
5/17/2021 Event on 5/16/2021 (0.59 in.)	5/17/2021

5/21/2021
Event on 5/21/2021 (0.41 in.)

5/21/2021

5/24/2021
Event on 5/23/2021 (0.69 in.)

5/24/2021

	
6/2/2021 Event on 6/1/2021 (0.28 in.)	6/2/2021

	
6/9/2021 Event on 6/8/2021 (0.56 in.)	6/9/2021

	
6/25/2021 Event on 6/24/2021 (0.83 in.)	6/25/2021

	
6/28/2021 Event on 6/27/2021 (0.79 in.)	6/28/2021

	
7/14/2021 Event on 7/13/2021 (0.51in.)	7/14/2021

	
8/20/2021 Event on 8/19/2021 (0.25 in.)	8/20/2021

9/3/2021
Event on 9/2/2021 (0.34 in.)

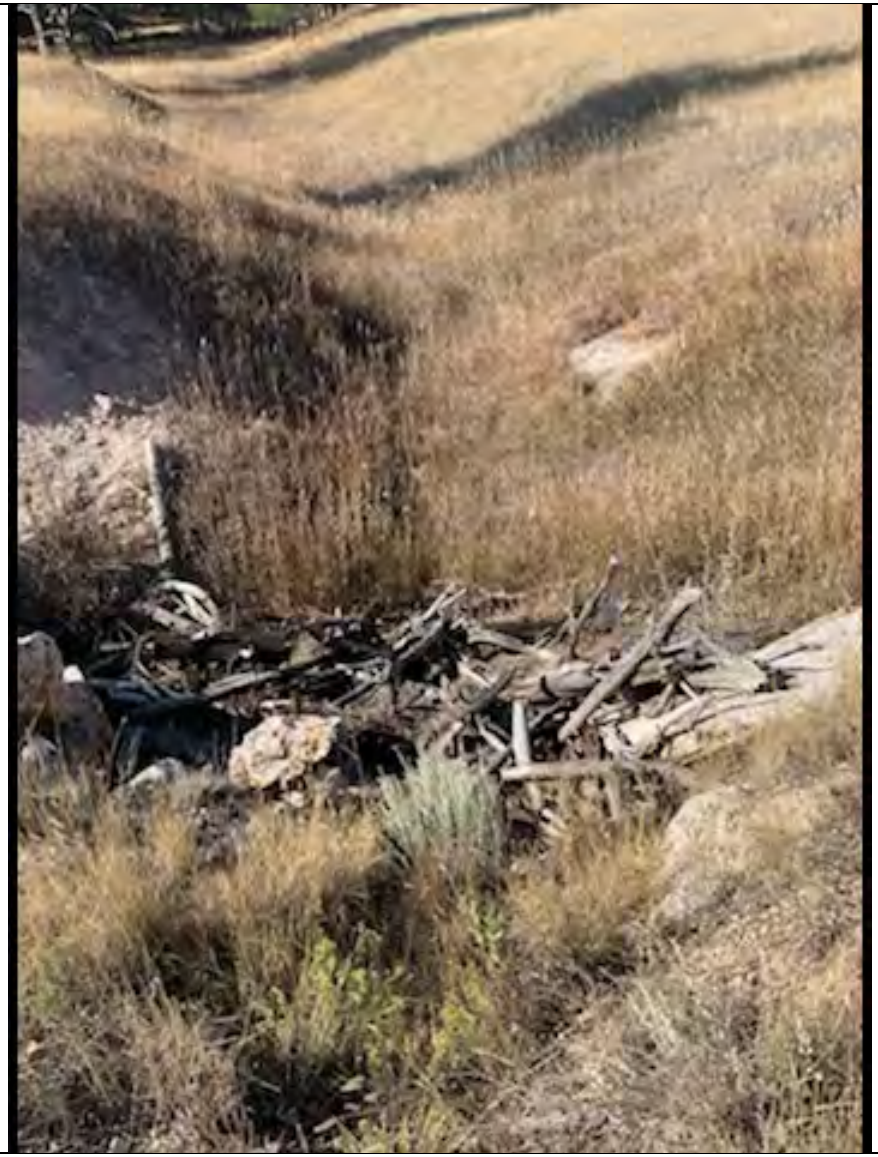
9/3/2021

9/14/2021
Event on 9/13/2021 (0.36 in.)

9/14/2021

	
10/13/2021 Event on 10/12/2021 (1.58 in.)	10/13/2021

10/22/2021
Event on 10/21/2021 (0.30 in.)



10/22/2021

	
4/25/2022 Event 4/22/2022 – 4/24/2022 total of 1.02 in.	4/25/2022

Appendix D:

Groundwater Monitoring Results

Spring

Parameter	7/21/2020	3/30/2021	4/27/2021	5/27/2021	6/17/2021	7/29/2021	8/19/2021	9/28/2021	10/12/2021	11/2/2021
TDS (mg/L)	365	324	281	324	335	431	408	395	380	365
TSS (mg/L)	< 10.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chloride (Cl-) (mg/L)	na	10.7	11.2	12.5	19.4	25.1	27.8	25.5	21.0	15.3
Nitrogen, Nitrate (NO3) (mg/L)	4.82	1.98	2.29	3.01	5.66	6.64	7.8	6.6	5.76	3.83
Fecal Coliform (CFU/100 mL)	na	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Field Conductivity (umhos/cm)	302	232	594	588	639	704	763	768	697	672
Field pH (S.U.)	7.46	7.85	7.19	7.8	7.43	7.52	7.59	7.59	7.66	7.78

67605 Domestic Well

Parameter	7/21/2020	3/30/2021	4/27/2021	5/27/2021	6/17/2021	7/29/2021	8/19/2021	9/28/2021	10/12/2021	11/2/2021
TDS (mg/L)	375	301	301	325	338	417	400	364	371	382
TSS (mg/L)	< 10.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chloride (Cl-) (mg/L)	na	10.6	11.2	12.1	19.6	24.2	28.7	17.3	17.3	19.8
Nitrogen, Nitrate (NO3) (mg/L)	6.11	1.98	2.3	3.14	5.91	6.58	7.43	4.31	4.45	4.45
Fecal Coliform (CFU/100 mL)	na	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.0	< 2.0	< 2.0	< 2.0
Field Conductivity (umhos/cm)	355	263	594	589	646	718	738	715	701	730
Field pH (S.U.)	7.53	7.74	7.34	7.87	7.45	7.53	7.57	7.69	7.75	7.75

*Hilighted cells indicate the time period where the spring-fed well was inadvertantly sampled rather than the domestic well.

61831 Stock Well

Parameter	7/21/2020
TDS (mg/L)	442
TSS (mg/L)	< 10.0
Chloride (Cl-) (mg/L)	na
Nitrogen, Nitrate (NO3) (mg/L)	3.66
Fecal Coliform (CFU/100 mL)	na
Field Conductivity (umhos/cm)	434
Field pH (S.U.)	7.72

Appendix E:

Storm Water Pollution Prevention Plan

Loring Pit Storm Water Pollution Prevention Plan (SWP3)

Prepared by: Mike Lee, Environmental Manager

Date: 5/2/2019
Last Updated: May 2019
Next Scheduled Review: May 2022

Certification:

"I T. Scott Olsen (responsible corporate official) certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation."

T. Scott Olsen – Regional Manager	605-394-3300
(Name/Official Title)	(Telephone)
T. Scott Olsen	10/31/19
(Signature)	(Date)

Table of Contents

1.0 General Facility Information

Mailing Address:
Simon
P.O. Box 2720
Rapid City, SD 57709

Location:
Simon
Loring Quarry
12066 18 Mile Rd
Custer, SD 57730

Emergency Contact: Francis Zeimet	**Work Phone:** (605) 745-5206
Title: Superintendent	**Emergency Phone:** (605)890-5206
Secondary Contact: Mike Lee	**Work Phone:** (605)394-3320
Title: Environmental Manager	**Emergency Phone:** (605) 390-8439
Type of Facility: Construction sand and gravel mining	**SIC Code:** 1442 **NAICS Code:** 212321
Number of Storm Water Outfalls: 1	**Receiving Waters:** Carroll Creek
NPDES Permit Number: SDR00A294	

1.1 Site Assessment

The Loring Siding Quarry is located five miles south of Pringle, SD, on Highway 89. The actual quarry encompasses approximately 50 acres with an additional 100 acres of undisturbed property surrounding the quarry, which is also part of this site. This quarry is used infrequently and is not regularly staffed.

On-site, there is one 10' x 12' scale house. A loader is kept on-site as needed. No fuel tanks are kept on-site, so a fuel truck on an as needed basis fuels the loader. Several stockpiles of crushed rock and fines are stored on-site and used as needed. There is no paving on-site and areas not disturbed are vegetated with trees and natural grasses.

The portable crusher is moved on-site intermittently. When it is on site a 1000-gallon fuel tank and 55-gallon waste oil tank are moved on site also. These tanks are contained inside a secondary containment. The runoff that results from the crushing operation is retained on-site in retention ponds.

There is a possibility that the portable hot plant would be moved on-site as well. This has not occurred yet but if a job warranted it, then it would be placed on this site. If the hot plant were to be moved on-site, then hot plant's SWPPP would be used to prevent pollution of storm water runoff.

The storm water is either retained in the quarry or drains off the site via a vegetated swale by an old railroad grade. The water then drains under the grade and eventually into Carroll Creek about 1 mile east of the site. The old railroad grade is abandoned and has been converted into a hiking and biking trail.

2.0 Overview

2.1 Introduction

This storm water pollution prevention plan (SWPPP) has been prepared for Simon - Loring Pit, located 12066 18 Mile Rd, Custer, SD 57730. It has been developed as required under Part 4.4 of the South Dakota Surface Water Discharge Program's General Permit for Storm Water Discharges Associate with Industrial Activity. This SWPPP describes this facility, recommends appropriate best management practices (BMPs) or pollution control measures to reduce the discharge of pollutants in storm water runoff, gives a materials inventory, gives a description of materials exposed to storm water, and provides for periodic review of this SWPPP.

2.2 Objectives

The goal of the storm water permit program is to improve the quality of surface waters by reducing the amount of pollutants potentially contained in the storm water runoff being discharged. Industrial facilities subject to storm water permit requirements must prepare and implement a SWPPP for their facility.

The objective for this SWPPP is three-fold:

1. To identify potential sources of pollution at Loring Pit,
2. To describe best management practices (BMPs) which are to be used at Loring Pit, and
3. To provide other elements such as, but not limited to, a facility inspection program, site compliance evaluation program, record keeping and reporting program that will help Loring Pit comply with the terms and conditions of their storm water discharge permit.

3.0 Plan Coordinator Duties and Pollution Prevention Team

The SWPPP coordinator for the facility is: Mike Lee, Environmental Manager, (605) 394-3320. The coordinators duties include:

- Create a SWPPP team to aid in the implementation of the SWPPP,
- Implement the SWPPP,
- Oversee maintenance practices identified as BMPs in the SWPPP,
- Implement and oversee employee training,
- Conduct or provide for inspection or monitoring activities,
- Identify other potential pollutant sources and make sure they are corrected,
- Prepare and submit reports, and
- Ensure that any changes in facility operation are addressed and incorporated in the revisions of the SWPPP.

The following team people will be part of the Pollution Prevention Team and jointly responsible for implementation of identified BMP's in this SWPPP.

Team Member: Francis Zeimet
Title: Superintendent
Office Phone: (605) 745-5206
Emergency Phone: (605) 890-5206
Responsibilities: Promote good housekeeping and maintenance of storm water pollution prevention activities as outlined in this plan.

Team Member: Mike Lee
Title: Environmental Manager
Office Phone: (605)394-3320
Emergency Phone: (605)390-8439
Responsibilities: Support Team Leader in promoting good housekeeping and providing manpower and equipment necessary to implement and maintain storm water pollution prevention activities, as outlined in this plan.

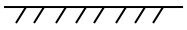
4.0 Potential Sources of Pollutants

4.1 Site Map

Figure 1 presents a site map of the facility showing the following features:

- Property boundaries,
- Buildings and other permanent structures,
- Storage or disposal areas for significant materials,
- Storm water discharge outfalls (locations where storm water is, or may be, discharged),
- Location of Storm Water inlets contributing to each outfall,
- Outlines of drainage areas contribution to each outfall,
- Structural runoff controls and storm water treatment facilities,
- Areas of vegetation,
- Areas of exposed and/or erodible soils,
- Impervious surfaces (roof tops, asphalt, concrete)
- Names and locations of receiving waters,
- Areas of known or suspected spills or leaks,
- Locations where the following activities are exposed to storm water:
    - Fueling stations,
    - Vehicle and equipment maintenance and/or cleaning areas,
    - Waste storage, treatment, or disposal areas,
    - Liquid storage tanks,
    - Equipment operating areas,
    - Processing areas,
    - Storage areas,
- Any other areas deemed appropriate.

LEGEND



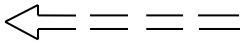
EXPOSED FACE

PAVED AREA

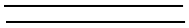
FENCE

STORAGE SHED

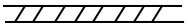
DIRECTION OF RUNOFF



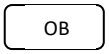
DIRECTION OF SWALE



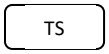
ROAD (GRAVEL OR DIRT)



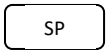
PAVED ROAD



OVERBURDEN PILE



TOPSOIL PILE

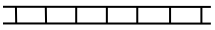


GRAVEL OR ROCK STOCK PILE

FUEL TANK

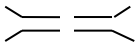
SCALE HOUSE

CONVEYOR



RAILROAD

SITE BOUNDARY

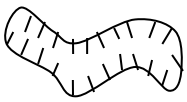


CULVERT

STORAGE BIN/LOADING BIN

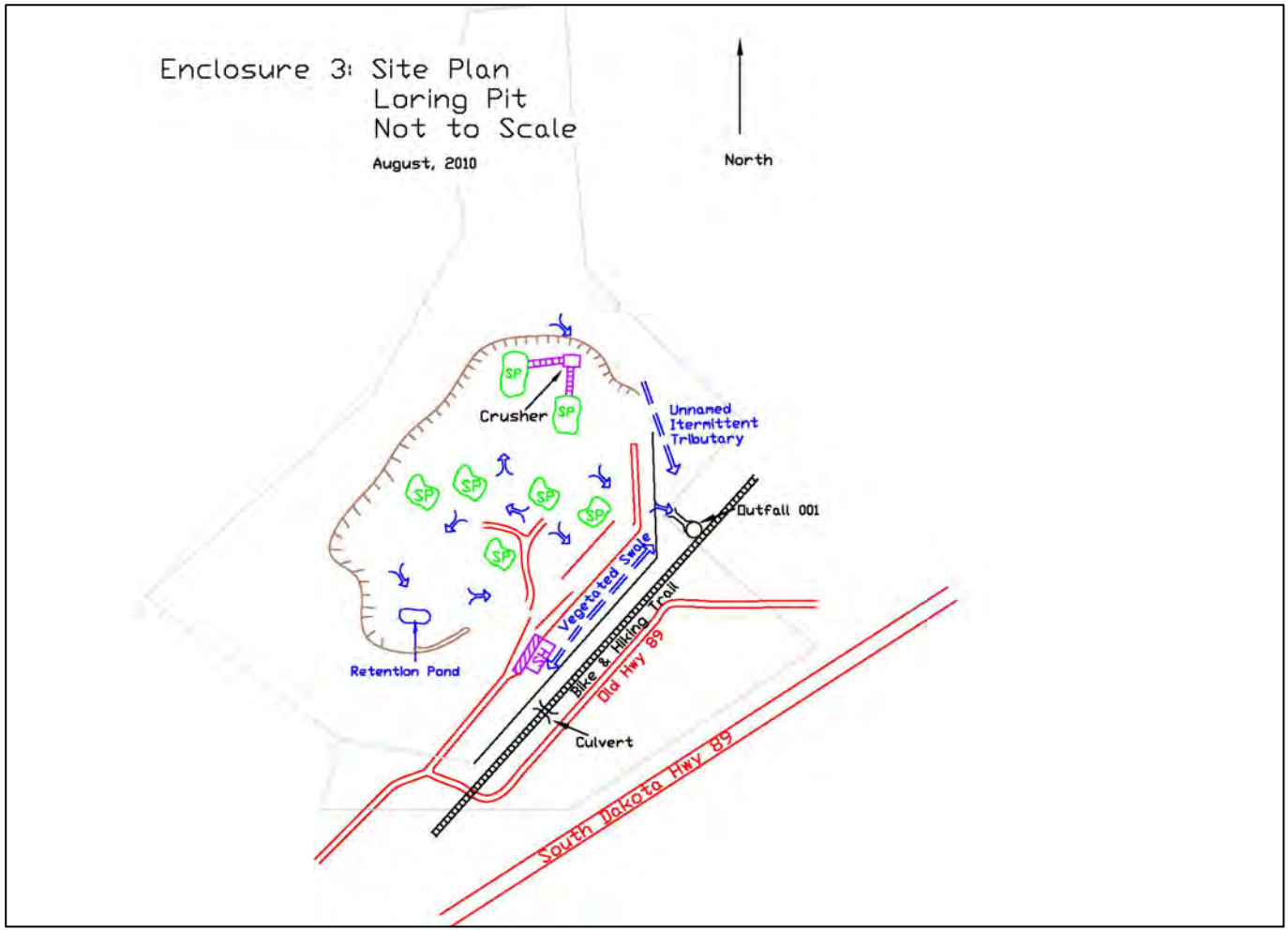
CREEK (WET OR DRY)

BERM



POND

Figure 1. Simon - Loring Pit located at 12066 18 Mile Rd, Custer, SD 57730.



4.2 Inventory of Materials

Table 1 contains an inventory of the types of materials handled at Loring Pit that have potential to cause pollution to storm water.

Table 1

Area/Process	Material(s)	Method of Exposure	Outfall	Controls
Stock piles	Coarse & Fine Aggregates	Rainfall	none	Drainage to retention areas
Equipment Parking area	Oil/other fluid drips	Rainfall	none	Daily equipment walk-arounds, sorbent materials on site

4.3 Spill Incidents

Significant spills are listed in Table 2. According to facility records there have been no "significant" spills on site.

A significant spill includes, but is not limited to releases of oil or hazardous substances in excess of reportable quantities under section 311 of the Clean Water Act (40 CFR 110.10 and CFR 117.21) or section 102 of CERCLA (40 CFR 302.4).

Table 2

Date	Material	Volume	Location	Actions Taken
None	None	None	None	

4.4 Existing Monitoring Data

Monitoring and sampling will be done as often as deemed necessary by the permit or the Plan Coordinator. Results of sampling and testing are in Table 3.

Table 3

Date	Location	Parameter	Non-Storm Water Discharge detected	Initials	Additional Information
None	None	None	None	None	

5.0 Best Management Practices

Storm water management controls, or best management practices (BMPs), will be implemented to reduce the amount of pollutants in storm water discharged from Loring Pit. The BMP's in this SWPPP include:

- Good Housekeeping,
- Preventative Maintenance,
- Spill Prevention and Response,
- Sediment and Erosion Control,
- Management of Runoff,
- Employee Training, and
- Security.

5.1 Good Housekeeping

Good housekeeping practices are reinforced throughout the facility. Employees are trained and reminded of good housekeeping practices. The following practices are included in our good housekeeping routine:

- Maintain a clean and orderly facility (grounds and floors) by sweeping, shoveling, or vacuuming debris accumulated within our property,
- Institute a "clean as you go" mentality in all areas of operation,
- Remove debris, trash, and waste materials to be collected on a regular basis to eliminate the chance from entering storm water conveyance points,
- Cover trash cans and/or collection municipal drop boxes to eliminate storm water contamination,
- Store drums away from storm water drains and high vehicle traffic areas,
- Remove all unused containers and drums from the property as soon as possible,
- Inspect materials storage areas and clean any spills on a regular basis,
- The systematic elimination of aggregate and material handling spill points, and
- Spill absorption materials readily available at fueling and/or oil storage areas.

5.2 Preventive Maintenance

Preventive Maintenance involves the regular inspection, testing, and cleaning of storm water management devices and facility equipment. These inspections will help prevent conditions that could cause breakdowns or failures resulting in discharges of pollutants.

Table 4 includes the equipment/activities that will be included in the preventative maintenance program.

Table 4

Equipment/Activity	Perform Maintenance	Frequency
Daily Walk Arounds on all equipment	Walk arounds include looking for drips of oil or other fluids, checking hoses etc.	Daily for all equipment

5.3 Spill Prevention and Response

Areas where potential spills can occur and their adjacent drainage points are identified in the facility site map included in Figure 1. Minor spills and leaks are addressed under the housekeeping section of this plan and are cleaned accordingly.

All facility personnel are responsible for the following:

- Identify spills, leaks or potential problem areas,
- Perform initial containment, if possible, of leak or spill,
- Report all incidents to supervisor or designated Emergency Response Person and/or SWPPP Coordinator,
- If applicable contact Fire and/or Police department by dialing 911.

The SWPPP Coordinator or a designated supervisor is responsible for the following:

- Report releases in excess of the reportable quantities to the local emergency response center at: (605)773-3296 or after hours at (605)773-3231.
- Report releases in excess of the reportable quantities to the National Response Center (NRC) at: **(800)424-8802** or **www.nrc.uscg.mil/online.htm**
- Prepare and submit any necessary regulatory report.

5.4 Sediment and Erosion Control

The facility site map in Figure 1 identifies any bare areas that due to location, topography, and activity have a higher potential for erosion and sediment runoff. This map also identifies the controls utilized for stabilization and control of such areas. Below in Table 5 is a list of areas prone to soil erosion.

Table 5

Area of Concern	Control Measures
None	

5.5 Management of Runoff

The storm water at Loring Pit is contained on site by using berms and the slope of the property.

5.6 Employee Training

All Employees are trained and informed of the goals and responsibilities associated with this SWPPP. As a minimum, SWPPP training occurs once a year for all employees regardless of their responsibility within the facility and is covered additionally in monthly Toolbox Talks. In addition, employees should receive new hire environmental training and site-specific environmental training as part of their operator training.

Training will include, but is not limited to: an overview of the SWPPP, good housekeeping procedures, preventative maintenance procedures, material storage procedures, spill prevention, and response procedures, location of any storm water

drains, the location of raw materials, and waste with identified pollution potential. Training records are kept in the back of the binder for 3 years.

5.7 Security

There is a fence that completely surrounds the Loring Quarry. All entrances are locked when not in use.

6.0 Inspections

6.1 Comprehensive Site Compliance Evaluation (CSCE)

At a minimum the SWPPP Coordinator, or other qualified personnel, shall evaluate the entire facility for overall compliance with the storm water permit once per year. Comprehensive Site Compliance Evaluations are included in **Appendix 2.**

6.2 Periodic Inspections

In addition to the Comprehensive Site Compliance Evaluations (CSCE) described above, periodic visual inspections will also be done monthly. These monthly inspections should include at least one inspection that was done during or immediately after a significant rain event. These inspections will assure the proper operation of the equipment and all storm water controls.

Simon will take appropriate and prompt actions in response to inspections that require follow-up procedures.

Facility:	Date/Time:	Retain until (5 years):
Personnel Conducting Inspection:		

Overall Drainage: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**
Look at overall drainage plan, is it performing as planned. Are the separate areas working together to contain and control stormwater runoff for the entire site? Comments:_____
_____
_____

Petroleum **Storage:** ☐ **Good** ☐ **Needs Improvement – (Make Comments)**
Look at containment. Look for housekeeping, any signs of spillage, and secondary containment. Is the secondary containment large enough to contain the largest tank if it were to rupture and any water that might be standing in it?
Comments:_____
_____

Drainage Systems: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**
Look at drainage ditches and anything that is used to direct the flow of runoff. Look for any signs of erosion. Look at visible piping for signs of leakage. Check retention ponds for storage capacity. Can the ponds hold the amount of runoff flowing into them? Check the housekeeping in all the areas for any trash and clutter. Comments:_____
_____
_____

Hazardous Materials Storage: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**
Look at the containment used to store this type of material. Are there any signs of leakage? Check the secondary containment for this type of storage. Will it contain the largest tank if it were to spill and also allow for freeboard? A good rule of thumb is at least at least 110% of largest tank capacity. Check for signage to make sure this storage area is marked. Check records to make sure that an accurate accountability is kept. Check security of area to make sure no unauthorized use is occurring.
Comments:_____
_____

Vehicle Parking & Haul Roads: ☐ **Good** ☐ **Needs Improvement – (Make Comments)**
Check the Drainage off the parking lots and haul roads. Is there a lot of sediment flowing off these areas? Check the overall conditions of the surface. Is there rutting and potholes? Is it flowing where it can be controlled or contained? Check the surface for spillage. Are vehicles leaking on the surface, which in turn can get into the runoff? Check the vehicle inspection records to make sure routine maintenance is kept up and daily walkarounds are being performed. Comments:_____
_____
_____

I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

INSPECTOR'S Signature:_____Date:_____

7.0 Non-Storm Water Discharges

There are no non-storm water discharges currently present at this site.

Certification of Evaluation of Non-Storm Water Discharges

I (responsible corporate official) certify under penalty of law that the storm water drainage system in this SWPPP has been tested or evaluated for the presence of non-storm water discharges either by me, or under my direction and supervision. To the best of my knowledge and belief, the information submitted is true, accurate, and complete. And at the time this plan was completed no unauthorized discharges were present. I am aware that there are significant penalties for submitting false information, including the possibility of fine of imprisonment for knowing violations.

_____	_____
(Signature)	(Date)
T. Scott Olsen	Regional Manager
(Printed Name)	(Title)

8.0 Record Keeping and Reporting

8.1 Storm Water Pollution Prevention Plan

The permit requires that the SWPPP plan be reviewed for its effectiveness and that changes be made as needed. A record shall be kept of any changes that have been made and the reason for the changes. Facility records will also include information pertaining to significant spills, what actions were taken as result of the spill, facility inspections, unauthorized discharges, training, and site evaluations will be kept in the facility files along with this SWPPP.

Table 6. Plan Review/Amendment Log.

Activity	Who & Date	PE Cert	Comments
3-year Scheduled Review	Clint Allen 6/1/12	No	Re-wrote entire SWPPP. Changes made to responsible person and team members. Added shingles, fuel discharge info., and other minor changes to site plan. Format changed but other information stayed the same
Updated certification pages to reflect change of General Manager	Clint Allen 6/1/2014	No	Updated certification pages to reflect change of General Manager
Administrative Update	Mike Lee	No	

9.0 Inspections and Memos

Inspection reports and memo are all kept in a separate tab near the back of the binder.

SIMON

STORM WATER BEST MANAGEMENT PRACTICES MANUAL

Compiled by:

www.h2eincorporated.com

The following manual is a collection of manufacture specific designs and good engineering practices intended to minimize impacts to storm water. Included are standard designs, installation specifications, and maintenance requirements for plan approved BMPs.

References

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Table of Contents

Check Dams (CD)

Description

Check dams (ditch checks) are small, temporary dams constructed across a diversion or roadside ditch. Check dams can be constructed using rock, sandbags, gravel bags, earth with erosion control blanketing, or synthetic materials to slow the velocity of concentrated flow in a channel and reduce in channel erosion. A secondary benefit of check dams is sediment trapping upstream of the individual check dams.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches		Sediment Traps/Basins
	Exposed Areas		Site Perimeter
○	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
○	Sand		
●	Loam		

Check dams can be used on mild or moderately steep slopes and in the following applications:

- Used to intercept and filter concentrated flows and dissipate erosive energy;
- In diversion or roadside ditches where seeding has been implemented but vegetation has not been established;
- Along temporary channels, ditches, or swales that need protection where construction of non-erodible lining is not practicable;
- Can be installed on soil or hard surface channels; and
- In areas subject to high flow velocities, provided that reinforced check dams are used.

Selection Considerations

- Generally, check dams should not be used in live streams;
- Use only in open channels that receive runoff from an area OF 10 acres or less; and
- Not for use in wetland areas or areas where vegetation has been established.

Design and Installation

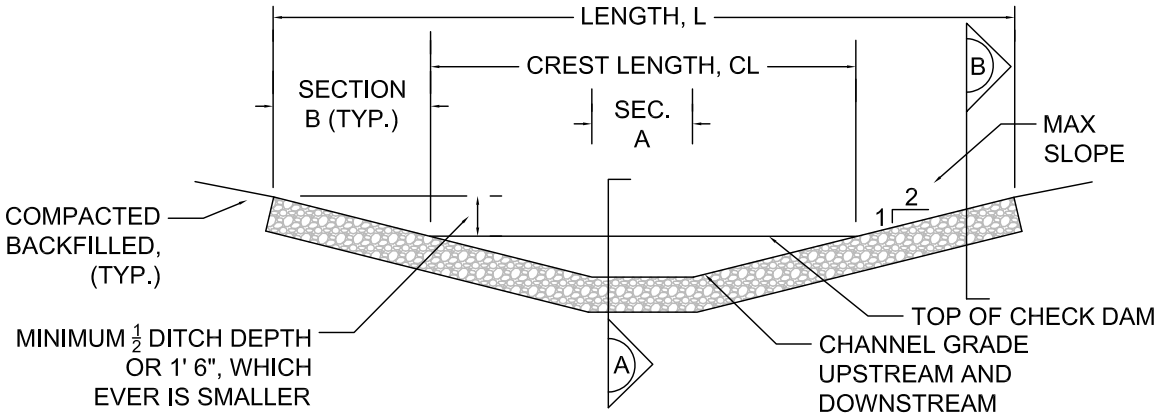
- Check dams shall be placed at regular intervals along swales or ditches;
- Check dams should be installed with careful placement of the construction material (do not simply dump rocks);
- Where multiple check dams are used, the top of the lower dam should be at the same elevation as the toe of the upper dam;
- Typical construction materials:
    - Crushed rock;
    - Sediment control log/wattles;
    - Sand/gravel bags; and
    - Reinforced crushed rock.
- All check dams should have sufficient space up slope from the check dam to allow ponding and to provide room for sediment storage; and
- Check dams are most effective when installed perpendicular to relatively straight sections of a ditch or open channel.

Maintenance and Removal

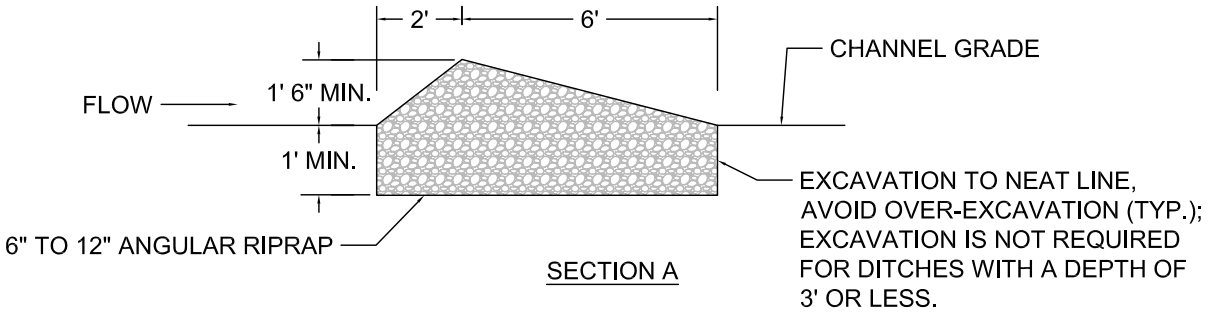
The frequency of inspections shall be in accordance with the Storm Water Plan. Inspect for sediment, trash, or other debris accumulations and visually inspect for erosion around the edges of the structure. Repair and replace as required to maintain functional check dams in accordance with the installation designs. Remove sediment accumulations reaching half or greater of the upslope crest height. Remove accumulated sediment prior to mulching, seeding or chemical soil stabilization.

The removal of check dams is optional when removal will have a negative impact on surrounding vegetated areas and/or when landowner approval is obtained. If removing a check dam, all accumulated sediment should be removed. Removal of a check dam should be completed only after the contributing drainage area has been completely stabilized. Permanent vegetation should replace areas from which rock or other material has been removed.

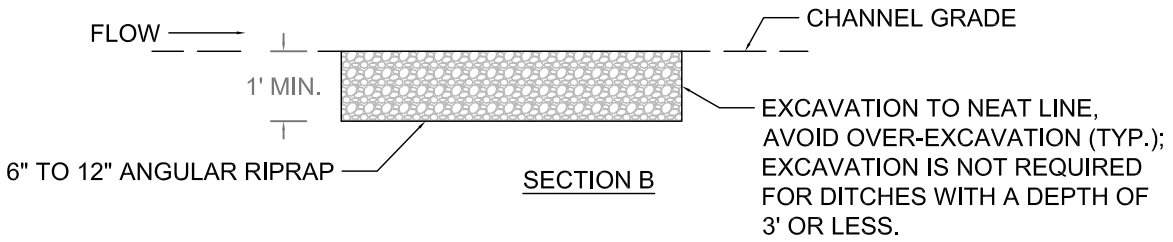
CHECK DAM FIGURES



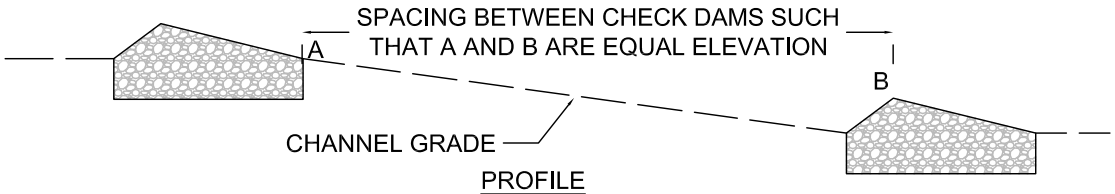
CHECK DAM ELEVATION VIEW



SECTION A



SECTION B



PROFILE

NOTE: DESIGN MODIFIED TO ACCOMIDATE INSTALLATION OF ROCK CHECK DAMS IN DITCHES <3' DEEP.

CHECK DAM NOTES

CHECK DAM INSTALLATION

1. SEE PLAN VIEW FOR:
   1.1. LOCATION OF CHECK DAMS
   1.2. CHECK DAM TYPE
   1.3. LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).
2. CHECK DAMS SHALL BE INSTALLED AFTER PERIMETER CONTROLS, BUT PRIOR TO ANY UPSTREAM LAND DISTURBING ACTIVITIES.
3. RIPRAP UTILIZED FOR CHECK DAMS SHOULD BE OF APPROPRIATE SIZE FOR THE APPLICATION. CHECK DAMS WILL BE CONSTRUCTED OF 6" TO 12" ANGULAR ROCK.
4. RIPRAP PAD SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1' FOR DITCHES WITH A DEPTH OF 3' OR GREATER.
5. THE ENDS OF THE CHECK DAM SHALL BE A MINIMUM OF 1/2 THE DITCH DEPTH, OR 1' 6", WICH EVER IS SMALLER.

CHECK DAM MAINTENANCE

1. INSPECT BMPS ACCORDING TO THE APPLICABLE STORM WATER PLAN SCHEDULE AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPS IN A PROACTIVE MANNER, NOT REACTIVE. INSPECT BMPS AS SOON AS POSSIBLE FOLLOWING APPLICABLE STORM EVENTS AND PERFORM NECESSARY MAINTENANCE.
2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPS IN EFFECTIVE OPERATING CONDITION. INSPECTION AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED.
3. WHERE BMPS HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.
4. SEDIMENT ACCUMULATED UPSTREAM OF THE CHECK DAMS SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS WITHIN 1/2 OF THE HEIGHT OF THE CREST.
5. CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED.
6. WHEN CHECK DAMS ARE REMOVED, EXCAVATIONS SHALL BE FILLED WITH SUITABLE COMPACTED BACKFILL. DISTURBED AREA SHALL BE SEEDED AND MULCHED OR OTHERWISE STABILIZED AS PROJECT APPROPRIATE.

Culvert (C)

Description

Culverts are a means of subsurface storm water conveyance where surface transport is not feasible. Culverts are most often used to convey water under a roadway without impeding use of the road.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches		Sediment Traps/Basins
	Exposed Areas		Site Perimeter
●	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay		Rocky Subgrade
●	Sand		
●	Loam		

Culverts may be used as:

- Ditch relief culverts to periodically relieve the roadside ditch by piping water to the opposite side of the road where the flow can be dispersed away from the roadway;
- Drainage crossings in streams and small channels typically under access roads; and
- A means of conveying storm water where surface transport is not feasible.

Selection Considerations

- Culverts can be utilized in crossings of major waterways, but require site specific design and may require additional permitting with state and federal agencies;
- Undersized culverts may cause flooding/ponding above inlet which may lead to erosion if water overtops or failure/washout of the culvert;
- As a general rule, culverts should be oversized rather than undersized to help mitigate future problems;
- If a location has limited height for installation of a culvert, consider installation of a “squash pipe” or arch pipes and box culverts (these maximize capacity while minimizing height);
- Culverts may fill with sediment and debris and require periodic cleanout; and

- Culverts may become crushed/damaged and require periodic maintenance.

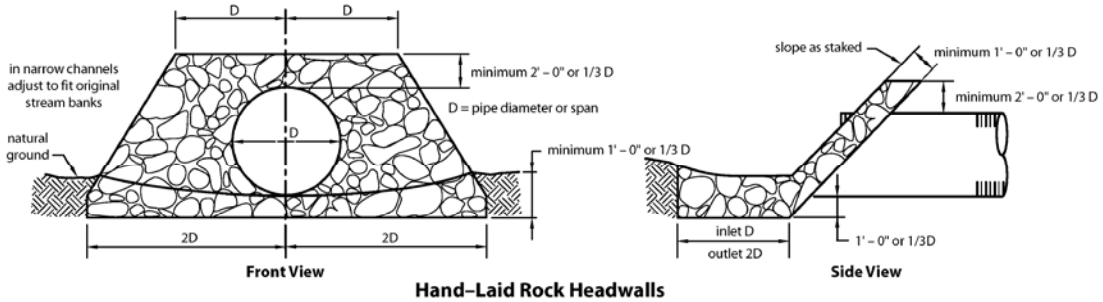
Design and Installation

- In the absence of site-specific designs or manufacture specific designs, this standard culvert installation design may be used, provided the design is appropriate for the situation;
- Culverts should have a minimum diameter of 18 in. or as site-specific hydrologic analysis indicates;
- The culvert outlet should extend at least 1 ft beyond the toe of any slope and discharge on grade;
- Ensure culvert discharges into a stabilized area (stabilization can be achieved with culvert outlet protection, erosion control blankets, or other similar stabilization BMPs);
- It may be necessary to install riprap or other energy dissipation devices at the inlet and outlet end of the culvert;
- Culverts may be constructed of concrete, corrugated metal pipe, corrugated plastic pipe (when properly bedded and backfilled);
- Inspect culverts for damage prior to installation (including any protective coatings such as Zinc);
- Culverts must be buried to a sufficient depth to ensure protection of the culvert and prevent lifting;
- When installing ditch relief culverts, try to install with an entrance angle of 45-60 degrees with the side of the ditch for better flow;
- Ditch relief culverts should have a greater gradient (at least 2% steeper) than the ditch for improved flow;
- Ditch relief culvert spacing is dependent on road grade and soils erosivity (reference Recommended Culvert Spacing Table for specifics);
- Most soils are satisfactory for use as bedding or backfill if free from obstructions such as roots or rocks (larger than 7.5 cm in backfill or larger than 3.8 cm in bedding) and do not have excessive moisture;
- Ideal backfill is moist, well graded granular or sandy gravel soil with up to 10% fines and free of rocks;
- Backfill needs to be well compacted (must match background compaction or a density of 90-95%);
- Uniform compaction is best achieved by backfilling in layers and compacting each layer individually; and
- Avoid the use of fine sand and silt rich soils for bedding material.

Maintenance and Removal

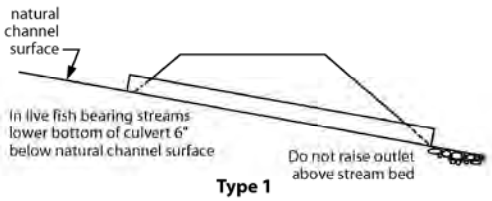
Inspections should be conducted in accordance with the Storm Water Plan. Inspect for damage, sediment buildup, or obstructed flow to culvert, inlet/outlet protection and promptly repair. Culverts are typically designed for permanent installation. If a culvert is removed, the disturbed area must be recontoured to match surrounding grade and stabilized. A culvert should only be removed when upslope concentrated flow is no longer directed to the culvert location.

CULVERT FIGURES

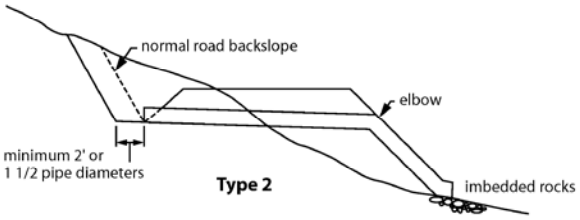


Hand–Laid Rock Headwalls

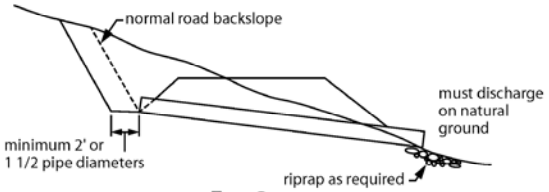
Culvert Construction Details



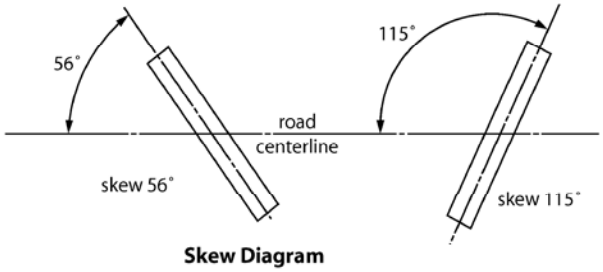
Type 1



Type 2

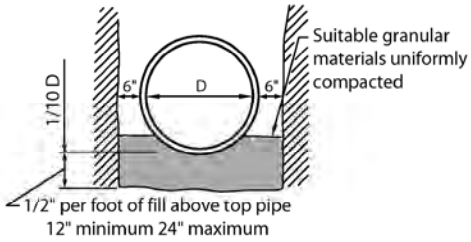


Type 3

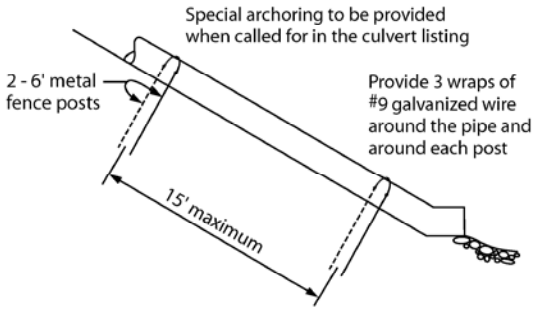


Skew Diagram

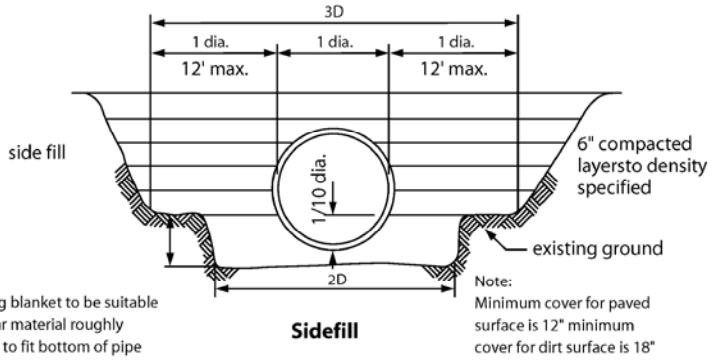
Typical Bedding Details



Rock Foundation



Special Anchoring Type 2 Downdrains

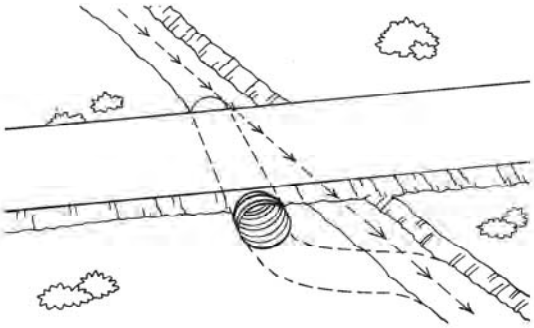


Note:
Bedding blanket to be suitable granular material roughly shaped to fit bottom of pipe

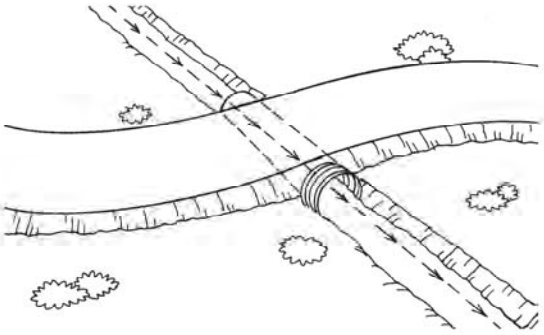
Sidefill

Note:
Minimum cover for paved surface is 12" minimum cover for dirt surface is 18"

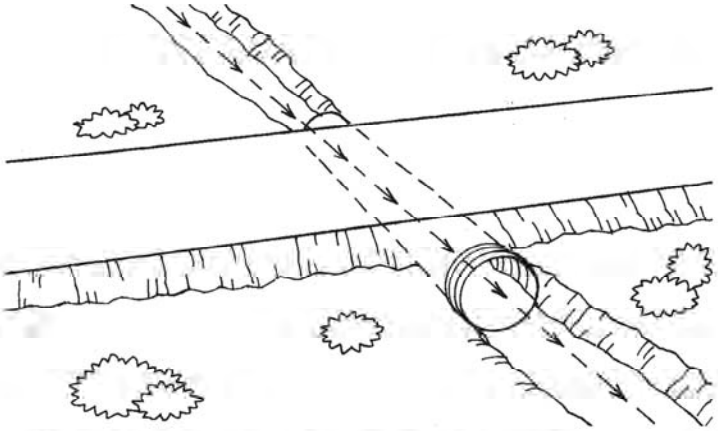
CULVERT FIGURES



Poor – Requires a stream channel modification.



Adequate – No channel modifications but requires a curve in the road.



Best – No channel modification, and the road is perpendicular to the culvert without a curve in the road alignment.

GENERAL CULVERT SIZING

DRAINAGE AREA (ACRES)	STEEP SLOPES LIGHT VEGETATION C=0.7	GENTLE SLOPES HEAVY VEGETATION C=0.2
	ROUND PIPE (IN)	ROUND PIPE (IN)
0 - 10	30"	18"
10 - 20	42"	24"
20 - 37	48"	30"
37 - 74	72"	42"

NOTES:
1. IF PIPE SIZE IS NOT AVAILABLE, USE THE NEXT LARGER PIPE SIZE. FOR INTERMEDIATE TERRAIN, INTERPOLATE BETWEEN PIPE SIZES.
2. PIPE SIZE IS BASED ON THE RATIONAL FORMULA AND CAPACITY CURVES. RAINFALL INTENSITY OF 3"/HR TO 4"/HR. VALUES OF "C" ARE THE RUNOFF COEFFICIENTS FOR THE TERRAIN.

NOTE: CULVERT SIZING IS IDEALLY BASED UPON SITE-SPECIFIC HYDROLOGIC ANALYSIS.

DITCH RELIEF CULVERT SPACING

SOIL TYPE	ROAD GRADE 2 - 4%	ROAD GRADE 5 - 8%	ROAD GRADE 9 - 12%
HIGHLY EROSIVE GRANITIC OR SANDY	240'	180'	140'
INTERMEDIATE EROSIVE CLAY OR LOAD	310'	260'	200'
INTERMEDIATE EROSIVE CLAY OR LOAD	400'	325'	250'
	MAXIMUM RECOMMENDED CULVERT SPACING		

Dewatering (DW)

Description

Dewatering applications typically involve the use of pumps to move water from an inundated area to an area suitable for discharge. The discharge point must have a sediment control BMP (e.g. dewatering bag, sediment basin/trap) prior to storm water moving downslope to a well vegetated area or other applicable storm water control. Typical dewatering operations have multiple inline BMPs to prevent erosion and control sediment movement.

Dewatering requirements will vary by project and site-specific features (soils, topography, discharge location, proximity to waterways, and anticipated water volume) will dictate the BMPs required.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

○	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- State and local jurisdictions may have additional criteria (e.g. dewatering must be retained on location) and/or permitting requirements;
- Dewatering of groundwater or water sources other than storm water may be prohibited by state and/or local regulations; and
- Dewatered storm water must be free of chemicals, hydrocarbons, and other contaminants.

Design and Installation

Dewatering operations must be continually manned to ensure proper function of the storm water controls and prevent off-site discharge of sediments.

Dewatering Bag:

- Size dewatering bag according to anticipated volume/pressure requirements;
- Ensure dewatering bag is firmly attached to discharge hose and that manufacture specific pressures/flow rates are followed;
- Place dewatering bag on relatively flat and stable ground (e.g. rock pad) or on strawbales; and
- Locate dewatering bag and/or install additional downslope controls to ensure dewatering bag does not cause erosion or uncontrolled downslope sediment movement.

Sediment Basin/Trap:

- Inspect existing sediment basin/trap for compliance with basin/trap design prior to use in dewatering;
- Monitor storm water leaving sediment basin/trap for evidence of sediment and modify controls/process if sediment is found to be discharging;
- Ensure discharge point into sediment basin/trap is at the opposite end of the control from the outlet; and
- Discharge into sediment basin/trap using preexisting stabilized inlet or add additional stabilization (e.g. riprap) to prevent erosion at discharge point.

Maintenance and Removal

Inspect all inline BMPs for proper function and stop dewatering operations if damaged or ineffective controls are identified.

If discharging directly into a dewatering bag:

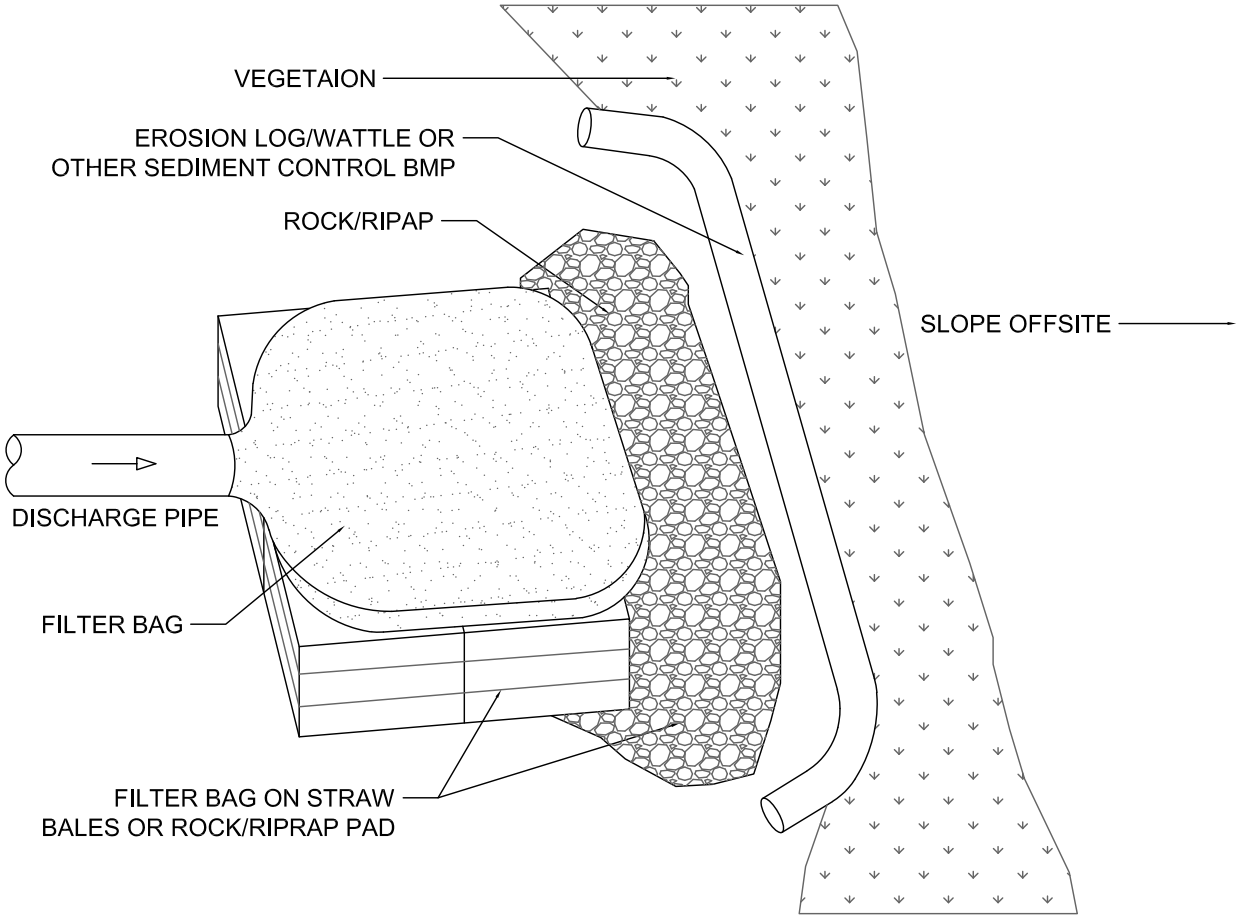
- Ensure bag is properly attached to hose;
- Inspect bag for tears/damage and replace as applicable;
- Monitor bag throughout dewatering operations for reduced flow caused by sediment buildup within the bag; and
- Cleanout or replace bag as necessary to maintain proper function or in accordance with manufacturer specifications.

If discharging directly into a sediment basin/trap:

- Remove sediment prior to the control reaching half filled;
- Monitor storm water leaving sediment basin/trap for evidence of sediment and modify controls/process if sediment is found to be discharging; and
- Follow all sediment basin/trap guidelines.

Remove dewatering bag and collected sediment once dewatering operations are complete. Collected sediment can be redistributed within origin area. Ensure waste dewatering bags are removed from location and disposed of properly.

DEWATERING FIGURES



DEWATERING FILTER BAG

Ditch/Drainage Swale (D/DS)

Description

A ditch or drainage swale is a drainage with a parabolic, trapezoidal, or V-shaped cross-section and may include a dike/berm on the lower side that is constructed across the slope. The purpose of a ditch is to prevent off-site storm water runoff (run-on) from entering a disturbed area, to prevent sediment laden storm runoff from leaving the construction site or disturbed area, to prevent flows from eroding slopes, and to direct sediment laden flows to a trapping device.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
○	Exposed Areas	●	Site Perimeter
○	Inlets and Outlets	●	Slopes
	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay		Rocky Subgrade
○	Sand		
●	Loam		

Ditches may be designed for temporary or permanent use. Regardless of timeframe, a ditch should be sufficiently constructed throughout to minimize the potential for failure. Ditches may be used for, but are not limited to:

- Up slope of cut or fill slopes to convey or divert flows away from disturbed areas;
- Down slope of cut or fill slopes to divert on-site runoff to a stabilized outlet or sediment trapping device;
- At the outer edge of a location to ensure that runoff remains on the pad and is diverted to a designated water collection system, such as a sediment trap, pond, etc. (if applicable);
- Where runoff from higher areas has the potential to cause erosion or interfere with the establishment of vegetation on lower areas;
- Where the slope lengths need to be reduced in order to keep soil loss to a minimum; and
- At the perimeter of a site or disturbed area.

Selection Considerations

- The area around a ditch, that is disturbed by its construction, must be stabilized (with vegetation or other erosion control);
- Overburden needs to be sufficiently compacted upon initial ditch construction;
- Ditches must be directed into a stabilized outlet, a well-vegetated area, or a sediment trapping device where sediment can be settled out of the runoff before being discharged into surface waters;
- Temporary ditches should be designed to avoid crossing vehicle pathways but if a ditch needs to cross a vehicle pathway, a culvert and or similar BMPs must be utilized; and
- Ditches should be used with caution on soils subject to slippage.

Design and Installation

- All ditches shall have uninterrupted positive grade to an outlet and shall be parabolic, trapezoidal, or V-shaped;
- Parabolic and trapezoidal shapes are preferred over V-shaped to minimize concentration of flow in center of ditch and limit erosion;
- The ditches shall be excavated or shaped to line, grade, and cross section as required to meet the specific criteria, depending on ditch design;
- All ditches must be cut to a minimum depth of 15 in. from the top of the ditch to the bottom center;
- The side slopes must be 3:1 (H:V) to ensure ease of maintenance, minimize erosion, and allow the ditch to adequately disperse flow;
- In the event of an excavated ditch and berm, all overburden needs to be sufficiently compacted along the ditch edge;
- All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the ditch. Ideally, the ditch will be cut in a location that avoids obstructions and or objects as to avoid additional disturbance;
- All earth that is removed and not needed in the construction process shall be spread or disposed of on the construction project so it will not interfere with the functioning of the ditch;
- Stabilization BMPs shall be incorporated into all ditches immediately after the channel is constructed in order to minimize erosion, degradation, and sediment deposition from the ditch;
- Permanent ditches must be seeded and mulched, hydroseeded, or covered with erosion control blanketing;
- Diverted runoff from a disturbed area shall be conveyed to a sediment trapping device; and
- Diverted runoff from an undisturbed area shall outlet to a sediment trapping device or into an undisturbed stabilized area at non-erosive velocities. Vegetative outlets shall be installed before ditch construction, if needed, to ensure establishment of vegetative cover in the outlet channel.

Ditches are usually located above or below cut or fill slopes. Exact ditch location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, and the development layout. Where possible on shallow slopes, a vegetative buffer strip should be left between the edge of the cut or fill slope and the ditch.

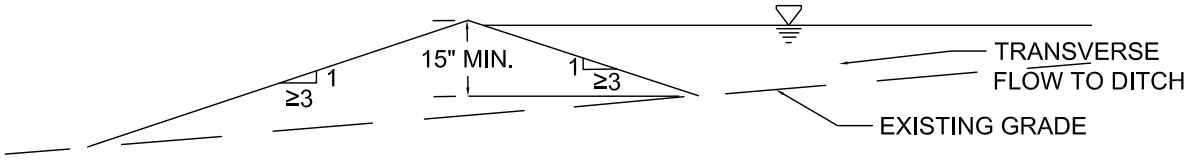
Ditches are usually not applicable below high sediment producing areas unless structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with or before the ditch.

Maintenance and Removal

The frequency of inspections shall be in accordance with the Storm Water Plan. Ditches should be cleared of sediment and repaired when necessary. Redistribute the sediment as necessary to maintain the capacity of the ditch and berm.

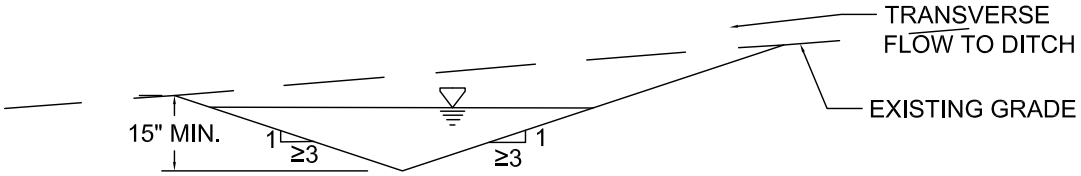
Ditches should remain in place and in good condition until the disturbed areas are permanently stabilized. If the ditches are not permanent, remove ditches once the overall facility is stabilized. Areas where ditches are removed should be stabilized with vegetation or other permanent stabilization methods.

DITCH/DRAINAGE SWALE FIGURES

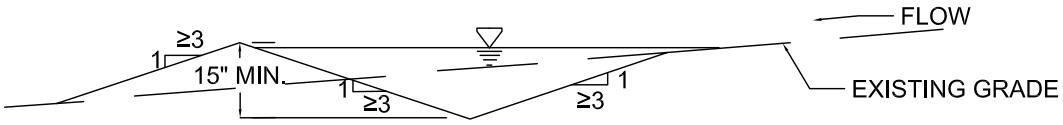


COMPACTED UNLINED EARTH DITCH FORMED BY BERM

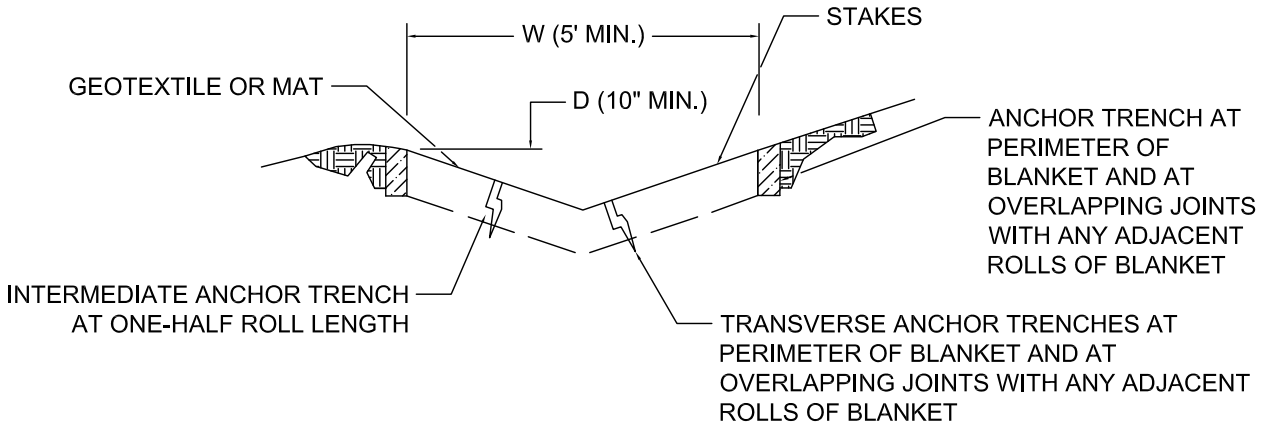
OPTIONAL: AN INTERIOR BERM IS OPTIONAL IF ALL OVERBURDEN GENERATED DURING THE CONSTUCTION PHASE IS REMOVED AND PROPERLY STORED ON LOCATION. ALL OVERBURDEN THAT REMAINS ALONG THE SIDES OF AN EXCAVATED DITCH (EXTERIOR & INTERIOR) MUST BE PROPERLY COMPACTED AND CONSTRUCTED AT A 3:1 SLOPE.



COMPACTED UNLINED EXCAVATED DITCH/SWALE



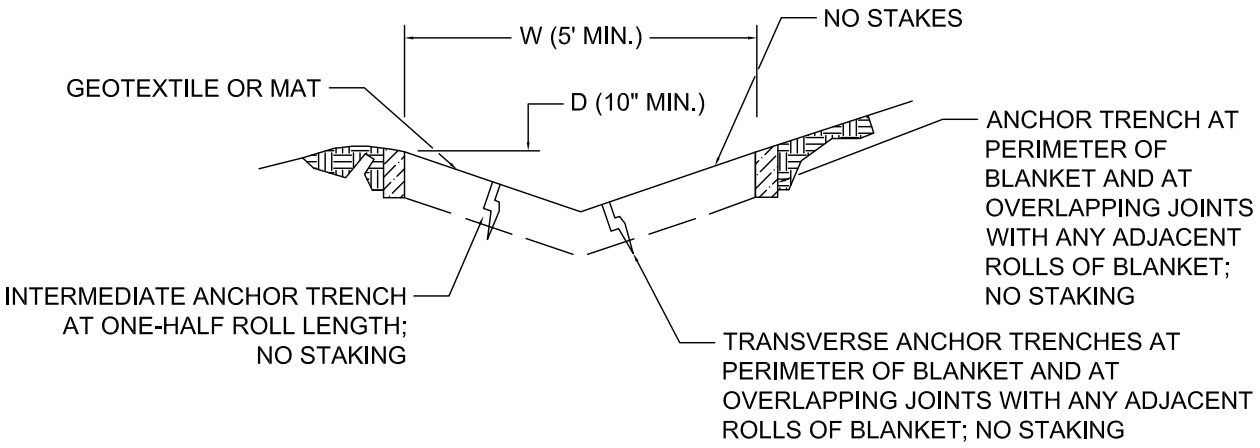
COMPACTED UNLINED EXCAVATED DITCH/SWALE FORMED BY CUT AND FILL



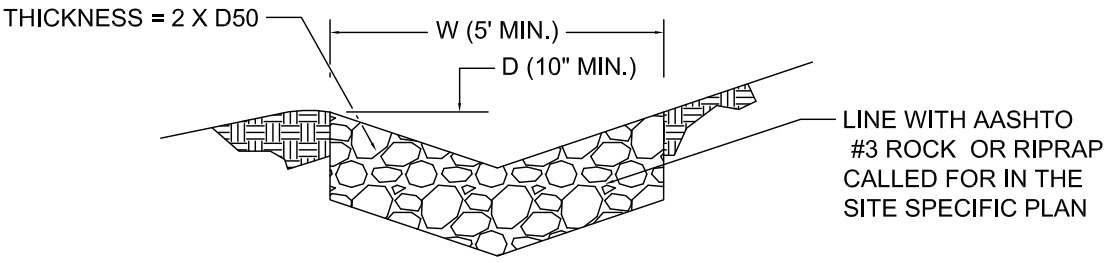
LINED DITCH/SWALE (CUT AND FILL OR BERM)

1. EXCAVATED OR FILL MATERIAL USED TO CREATE A DITCH/SWALE AND BERM MUST BE COMPACTED.
2. LOCATIONS WITH SITE-SPECIFIC ENGINEERED DITCH AND BERM DESIGNS WILL BE FOLLOWED IN LIEU OF THIS STANDARD DESIGN AND WILL BE DOCUMENTED IN THE SITE-SPECIFIC STORM WATER PLAN.

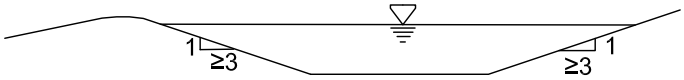
DITCH/DRAINAGE SWALE FIGURES



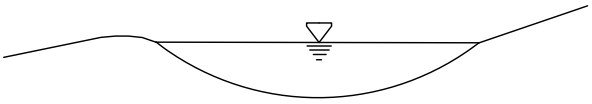
SYNTHETIC LINED DITCH/SWALE



RIPRAP LINED DITCH/SWALE



Trapezoidal Shape



Parabolic Shape

1. DITCH/SWALE SHOULD BE INSTALLED PRIOR TO LAND DISTURBING ACTIVITIES IN PROXIMITY.
2. EMBANKMENT AND BERMS SHOULD BE COMPACTED TO 90% OF MAXIMUM DENSITY AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT ACCORDING TO ASTM D698.
3. SWALES SHALL DRAIN TO A STABILIZED OUTLET AND/OR SEDIMENT CONTROL BMP.
4. FOR LINED DITCHES, INSTALLATION OF EROSION CONTROL/SOIL RETENTION BLANKETS SHALL CONFORM TO THE EROSION CONTROL/SOIL RETENTION BLANKET REQUIREMENTS.
5. WHEN CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION SWALE, INSTALL A TEMPORARY CULVERT WITH A MINIMUM DIAMETER OF 12 INCHES.
6. TRAPEZOIDAL OR PARABOLIC SHAPED DITCH/SWALES ARE PREFERRED SO THAT FLOW IS NOT CONCENTRATED IN THE BOTTOM CENTER OF A V DITCH. V DITCHES ARE EASIER TO CONSTRUCT AND MORE COST EFFECTIVE TO CONSTRUCT THEREFORE BETTER SUITED FOR TEMPORARY INSTALLATIONS.

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Ditch Turnout (DT)

Description

Ditch turnouts (diversion ditch) are used to disperse concentrated ditch flows (typically associated with roadways) into well vegetated areas. Ditch turnouts reduce flow volumes and velocities, therefore reducing erosion potential. Ditch turnouts are important for stability of unpaved roads.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
	Exposed Areas		Site Perimeter
●	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Ditch turnouts should be installed where long continuous roadside ditches and steep slopes combine to produce increased flow volume and velocities which may result in erosion;
- Ditch turnouts should only be installed where they will direct flows away from the road and roadside ditch into a well vegetated and stable area (typically in areas of gradual slopes); and
- If not properly installed/constructed, ditch turnouts can become another source of sediment.

Design and Installation

- Ditch turnouts should have a draining slope of ~3% and drain into a well vegetated area;
- Angle ditch turnouts at 20-40 degrees;
- Ensure that the receiving area will maintain its natural contour and that channelization does not develop;
- A ditch turnout should maintain the contour elevation without any sharp drops or changes in contour;
- A ditch turnout should typically only service an area of 2 acres or less;

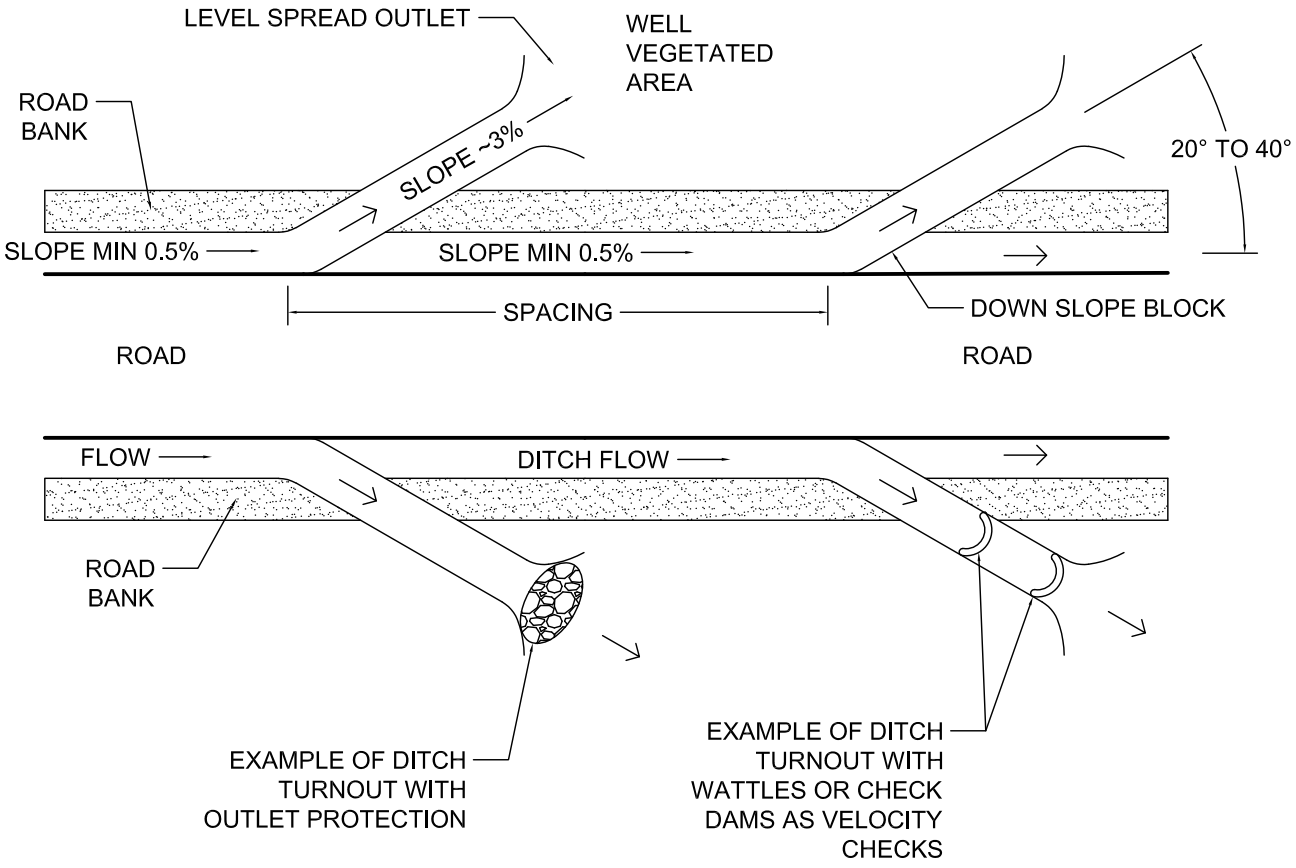
- Ditch turnout should be stabilized with vegetation, rolled erosion control products, riprap, or other applicable controls;
- Optional - outlet protection can be installed at the ditch turnout termination point;
- Optional - rock or wattle checks can be installed in ditch turnouts to control velocity and as sediment control; and
- Space ditch turnouts based on the grade and natural topography.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect ditch turnouts for signs of erosion, sediment buildup, bypass, and overall stabilization. Repair all erosion and implement additional BMPS as needed to address cause of erosion. Remove and redistribute sediment in its original source location.

Ditch turnouts are typically installed as a permanent control and do not require removal. In the event that a ditch turnout is removed, ensure the area is regraded to match the natural terrain and that the area is stabilized with alternative controls.

DITCH TURNOUT FIGURES



DITCH TURNOUT SPACING	
GRADE OF ROAD %	**DISTANCE BETWEEN DITCH TURNOUTS**
<2%	INSTALLER DISCRETION
2%	~200'
3-5%	~150'
5-10%	~100'
>10%	~80' OR LESS

1. TOPOGRAPHY, EXPECTED FLOW AND OTHER SITE SPECIFIC FACTORS MAY REQUIRE DEVIATIONS FROM SUGGESTED SPACING.
2. SPACING DITCH TURNOUTS CLOSER TOGETHER IS MORE EFFECTIVE THAN WIDER SPACING.

Earth Dike/Berm (ED/B)

Description

An earth dike (berm) is a temporary or permanent ridge of compacted soil located at the top or base of a sloping disturbed area to intercept and divert surface runoff away from areas not yet stabilized. It can also be installed around a pollutant source to prevent storm water and pollutants from leaving the location. Berms will typically be constructed from compactable subsoils which are sufficiently impermeable to retain water. Berms may be combined with lined or unlined drainage swales/ditches to divert storm water to additional sediment control BMPs prior to discharge from a site.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
●	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	●	Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
	Exposed Areas	●	Site Perimeter
○	Inlets and Outlets	●	Slopes
	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
○	Sand		
●	Loam		

With regular maintenance, the life span of earthen berms can last throughout the construction project. Berms can be used in, but not limited to, the following applications:

- Constructed across roadways (transverse berm) at a slight angle with respect to the centerline;
- Constructed along the top edge of cut/fill slopes to divert flows away from disturbed areas;
- Constructed along the toe of exposed and erodible slopes to divert on-site runoff into a stabilized outlet or sediment control BMP;
- Constructed mid-slope of a disturbed area to intercept runoff and reduce the effective slope length;
- May be used on relatively flat slopes to capture surface runoff to shorten the overall slope length before it has a chance to concentrate and cause erosion; or
- As secondary containment around pollutant sources.

Selection Considerations

- Berms may erode if not properly maintained, compacted, and or stabilized;
- Berms which intercept high velocity concentrate flows may be susceptible to erosion and may require additional means of stabilization;
- Must use a secondary erosion control device when sediment control is an objective; and
- If a berm is installed across a vehicle roadway or entrance, the berm shall be compacted and widened to prevent impediment to traffic while maintaining function as a berm.

Design and Installation

- Construct berms using subsoils or other material that can be compacted to be sufficiently impervious. Top soil **may not** be used to construct this BMP;
- Berms must be compacted manually or by mechanical means;
- Berms should be constructed prior to commencement of major land disturbance activities; and
- Berms used as secondary containment must be lined or compacted and sufficiently impervious to retain liquids until the next routine inspection.

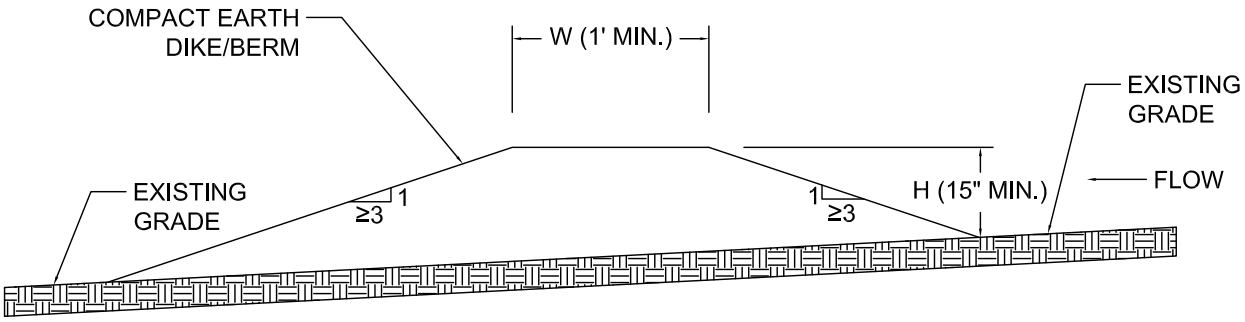
Maintenance and Removal

The frequency of inspections shall be in accordance with the Storm Water Plan. Berms should be inspected for signs of erosion, stability, and compaction. Any areas of damage or erosion should be repaired as necessary. If intensive or repeated maintenance is required to keep the control functional, then alternative or additional controls may be necessary.

When using berms, they should be maintained at or above the minimum required height.

Berms should remain in place and in good condition until the disturbed areas are permanently stabilized. If the berms are not permanent, remove berms once the overall facility is stabilized. Areas where berms are removed should be stabilized with vegetation or other permanent stabilization methods.

EARTH DIKE/BERM FIGURE



1. SOIL MUST BE COMPACTABLE AND SUFFICIENTLY IMPERVIOUS TO RETAIN/DEFLECT STORM WATER.
2. TOPSOIL SHALL NOT BE USED FOR THE CONSTRUCTION OF EARTHEN DIKE/BERMS.
3. MUST BE COMPACTED MANUALLY OR BY MECHANICAL MEANS.
4. BERMS USED AS SECONDARY CONTAINMENT MUST BE LINED OR COMPACTED AND SUFFICIENTLY IMPERVIOUS TO RETAIN LIQUIDS UNTIL THE NEXT ROUTINE INSPECTION.

Erosion Logs/Wattles (EL/W)

Description

Erosion logs/wattles are temporary sediment controls shaped as linear rolls and constructed of a combination of excelsior, straw, coconut fibers, wood chips, or compost. Erosion logs are typically trenched in and secured in place using stakes. When properly installed, erosion logs form a sediment barrier to intercept sheet flow runoff from the disturbed area. This results in the velocity of sheet flows being reduced thus allowing sediment to be captured before the runoff is released as sheet flow by the control.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

○	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
○	Sand		
●	Loam		

Typical uses include:

- To intercept surface runoff, reduce flow velocities and capture sediment;
- On disturbed slopes to shorten flow lengths;
- As check dams in small drainage ditches (low flow);
- As perimeter control for stockpiles and disturbance boundaries; and
- As inlet protection.

Selection Considerations

- Not recommended for use in ditches, swales, or channels where continuous flows or high-volume flows are anticipated;
- Not to be used below the high-water mark in stream applications;
- Only intended as a temporary control and will degrade with time;

- Function will degrade as sediment builds up in and behind the control; and
- Erosion logs are prone to undercutting when used on sandy soils.

Design and Installation

- Should be installed on contour (perpendicular to flow) when used to intercept sheet flows or as check dams;
- The typical maximum allowable tributary area is 0.25 acres with up to 150 ft of disturbed slope (no steeper than 3:1 (H:V)) for every 100 linear feet of erosion log installed;
- When used as perimeter control or other similar use, install in a manner that will minimize concentrated flows (e.g. J-hook ends);
- Ensure proper spacing based on flow line gradient and erosion log dimensions;
- Erosion logs must be trenched and staked if lighter than 8 lb/ft;
- Recommend stakes at ends of erosion logs/wattles be placed at a 90 degree angle from each other to prevent lifting of ends; and
- When used at the toe of a slope, place 5-10 ft beyond the toe of the slope to allow room for ponding behind the control.

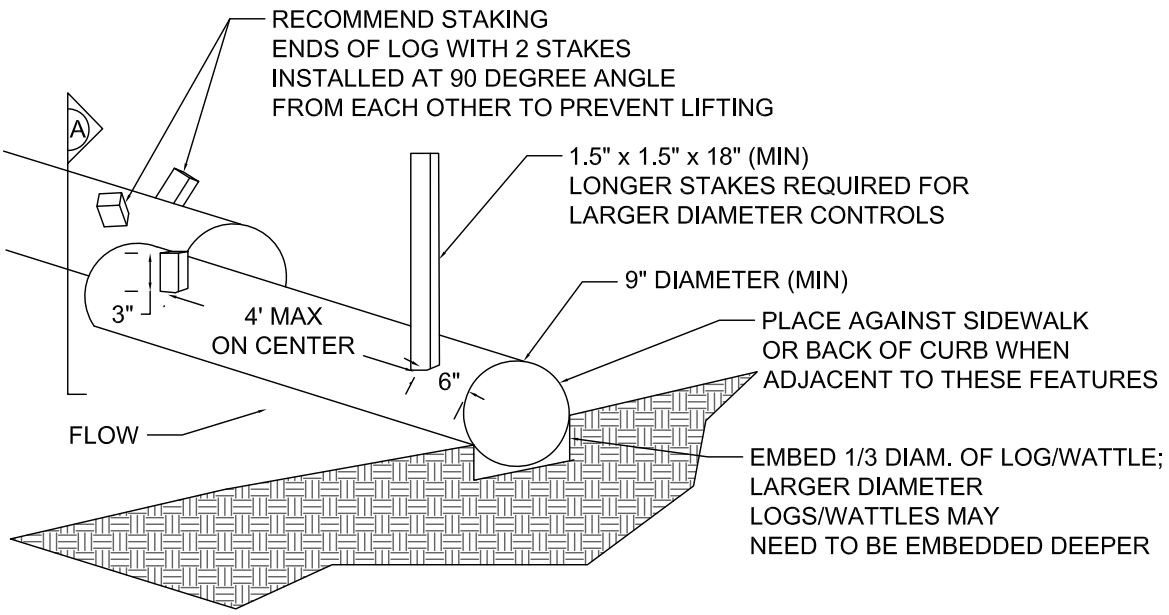
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect erosion control logs for damage, missing stakes, undercutting, improper installation, and sediment accumulation of 1/2 the height of the erosion log or greater. Initiate repairs, replacement or sediment removal as soon as possible.

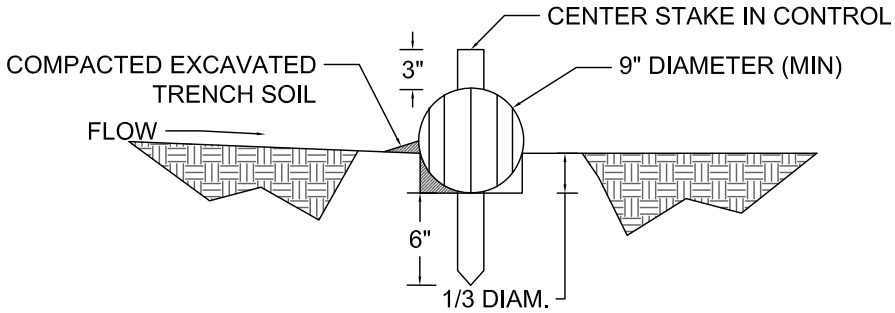
Erosion logs may be removed once the surrounding areas are stabilized. Areas disturbed under the controls may need seed/mulch. Erosion logs constructed of biodegradable materials may be left in place, especially when installed in difficult to reach or remote locations.

EROSION LOGS/WATTLE FIGURES

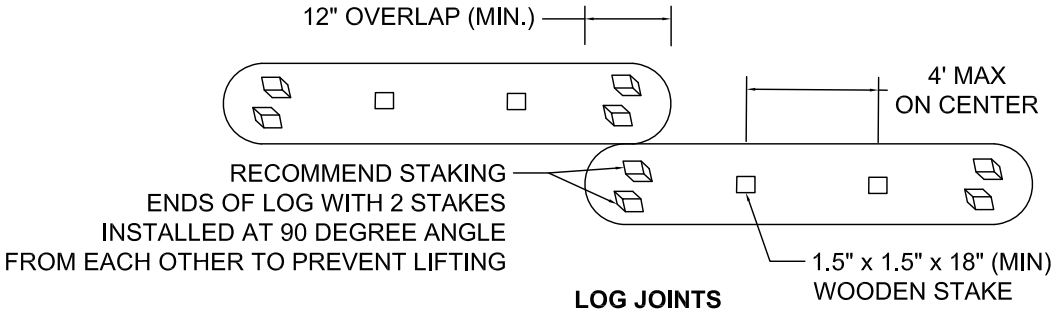
TRENCHED EROSION LOG/WATTLE DESIGN



TRENCHED SEDIMENT CONTROL LOG

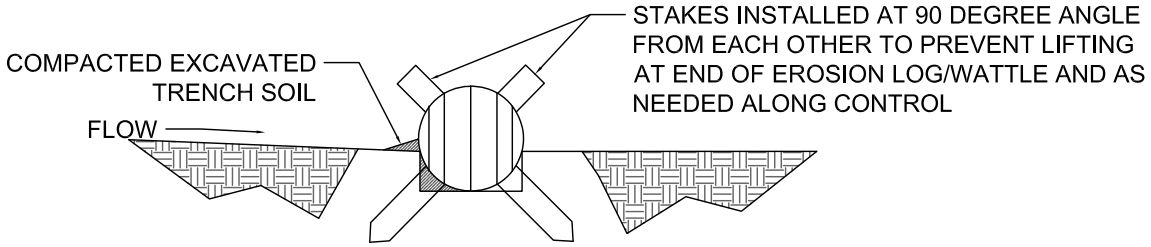


SECTION A TRENCHED SEDIMENT CONTROL LOG

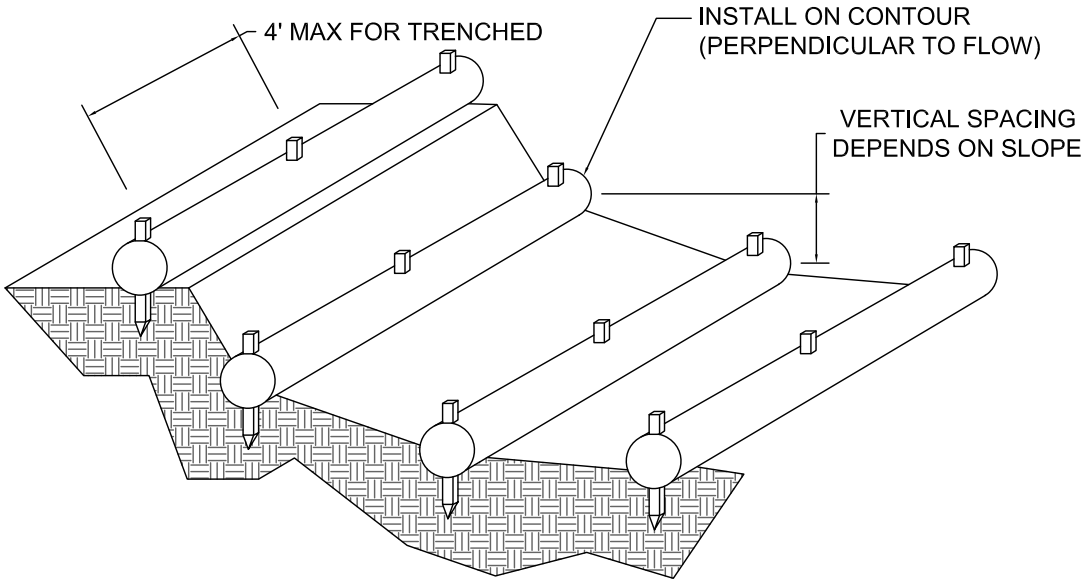


LOG JOINTS

EROSION LOGS/WATTLE FIGURES



SECTION A TRENCHED SEDIMENT CONTROL LOG WITH CROSS STAKED END



EROSION LOGS/WATTLES TO CONTROL SLOPE LENGTH

FLOW LINE GRADIENT	MAXIMUM SPACING BASED ON NOMINAL LOG DIAMETER (FEET)		
	8" TO 9"	12"	18" TO 20"
0% TO 2%	30'	55'	75'
2% TO 5%	25'	40'	55'
5% TO 10%	15'	30'	40'
10% TO 33%	10'	15'	20'
33% TO 50%	5'	10'	15'

Good Housekeeping Practices (GH)

Description

Good housekeeping practices must be implemented in order to prevent storm water contamination with solid and liquid wastes generated in the construction process. Good housekeeping practices include but are not limited to employee and contactor training, designating material storage/staging areas, implementing spill prevention procedures, and developing spill response and cleanup procedures.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control	●	Good Housekeeping
	Sediment Control		Snow Management
●	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	●	Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

Good housekeeping practices will be project specific and depend on the identified pollutant sources. The selected good housekeeping practices must be discussed in the storm water plan and, when applicable, identified on the site-specific diagrams/maps.

Design and Installation

Include a discussion of the following good housekeeping practices in the storm water plan and, as applicable, identify on the site-specific diagrams/maps. Incorporate the following as applicable to the project:

Training

- Is key to ensuring all employees and contractors understand the importance of good housekeeping and the protection of storm water from pollutant sources;
- Ensures all employees and contractors understand the requirements of the storm water plan and associated BMPs;

- Ensures all employees and contractors are prepared to identify and respond to an uncontrolled pollutant source; and
- Facilitates discussion between the owner/construction manager and their employees and contractors.

Material Handling and Storage/Staging

- Retain all Safety Data Sheets (SDS) in an accessible location for all stored materials, chemicals, and hydrocarbons;
- Do not remove original manufacturer labels;
- Keep stored materials, chemicals, and hydrocarbons in original containers or properly designated containers;
- Keep bagged and boxed materials on pallets or similar elevated storage area (do not place directly on ground);
- Provide appropriately sized secondary containment or storage containers for applicable materials, chemicals, and hydrocarbons;
- Clearly designate delivery and storage areas;
- Routinely inspect storage for damaged, leaking, or improperly stored materials, chemicals, or hydrocarbons;
- Storage sheds/containers must be leak free;
- Minimize storage of materials, chemicals, and hydrocarbons on location (limit to anticipated need in a timely manner); and
- Keep well organized and leave adequate room between stored products to facilitate inspection, cleanup, or emergency response actions.

Waste Management

- Provide designated containers for trash disposal and recycling (if applicable);
- Ensure all waste containers are covered to prevent storm water contact or wind movement;
- Segregate wastes by type for proper disposal;
- Ensure all employees and contractors working on location are routinely cleaning the construction site of trash;
- Locate waste collection containers near waste sources or at the construction entrance; and
- Routinely empty waste containers to prevent overfilling.

Hazardous Materials and Waste

- If applicable, designate hazardous waste collection area(s);
- Provide adequately sized secondary containment for all hazardous waste storage;
- Properly label and handle all hazardous wastes; and
- Follow company specific waste management guidelines.

Sanitary and Septic Waste

- Provide onsite toilet facilities while construction is ongoing;
- Locate toilet facilities in convenient locations but away from waterways, wetlands, or other sensitive areas;
- All portable toilets must be staked, tied, or otherwise secured to prevent tipping; and
- Routinely dispose of sanitary and septic waste in accordance with state or local regulations.

Equipment/Vehicle Fueling and Maintenance

- Minimize the fueling and maintenance of equipment and vehicles on the construction site;
- Only minor unscheduled maintenance should be conducted on location, provided it can be done while protecting storm water;
- Routine and major maintenance should be conducted off location;
- Keep spill kits/materials on location near on-site fueling and maintenance areas;
- Routinely inspect vehicles and equipment for leaks;
- All chemical and fuel transfer operations shall be continuously monitored to minimize the risk of spills; and
- Use absorbent pads, drip pans, or other fluid control measures when drips or spills are possible.

Equipment/Vehicle Washing

- Minimize on-site vehicle and equipment washing;
- Use off-site dedicated washing facilities when possible;
- Keep wash water on location and treat with applicable BMPs; and
- Do not allow wash water to discharge off of the construction location.

Spill Prevention and Response Plan

- Develop a written spill prevention and response plan (may incorporate SPCC plan(s));
- Identify employees and/or contractors responsible for spill prevention and response;
- All employees and contractors shall adhere to company specific environmental, health, and safety plans, rules, and programs;
- Prioritize employee, contractor, and public safety followed by stopping the source of a spill and containing on-site;
- Keep an ample supply of spill cleanup materials and equipment near storage, loading/unloading, and refueling areas;
- Adhere to all federal, state, and local rules and regulations for response, cleanup, reporting, and disposal.

Hydraulically Applied Mulch (HM)

Description

Hydraulically applied mulch is a temporary stabilization control measure that facilitates long term stabilization by promoting vegetation establishment. Hydroseeding equipment is used to apply a layer of natural and biodegradable fibers, along with an adhesive-like material, uniformly over disturbed soil areas. The combination of natural fibers and adhesive-like material protects the soil from rainfall impacts, channeling, wind erosion, and protects seed until permanent vegetation is established. Seed and other enhancements such as fertilizer may be applied in the hydromulch solution in certain circumstances.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
●	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

- Provides immediate but temporary stabilization once applied;
- Can be used as temporary stabilization where dirt work is complete or temporarily stopped and not anticipated to begin again for more than 14 days;
- Can be used as interim stabilization when season does not facilitate seeding operations;
- Helps to retain moisture, aid seed germination, and moderate soil temperatures facilitating vegetation establishment.

Selection Considerations

- Seed must be applied before or during hydromulch application when stabilizing in preparation for final stabilization;
- Application typically requires at least 24 hours drying time before exposure to precipitation;

- Livestock and wildlife can have a detrimental impact on the function and longevity of the application;
- Not recommended for areas of channelized or concentrated flows;
- Recommended for application on dry slopes of 2:1 (H:V) or flatter; and
- Application is not effective on saturated soils, areas with seeps, or seasonal springs.

Design and Installation

- Follow manufacturer recommended application rates or in the absence of manufacturer information, apply at a rate of no less than 1,500 lb/acre (1425 lb of fiber mixed with 75 lb of tackifier; for steeper slopes, up to 3000 lb/acre may be required);
- Recommend using maximum rate when applied to critical areas;
- Application must be uniform across exposed soils;
- Apply with a hydro-mulcher;
- Underapplication or "thin" applications are prone to failure when uniform coverage is not achieved;
- Avoid applications to roads, waterways, sidewalks, lined drainage channels and existing vegetation;
- Test a small area with hydraulically applied mulch prior to large scale application; and
- Recommend applying from multiple angles to ensure uniform distribution.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect for damaged areas typically resulting from human, wildlife, or livestock impacts. If small areas are found requiring repair, spread and hydrate granular hydraulic mulch products over the repair areas.

Hydromulch is biodegradable and does not need removal.

Mulching (M)

Description

Mulching is a temporary erosion control used to stabilize exposed soils while waiting for vegetation to establish. Mulch protects soils from rain impacts and wind erosion, increases infiltration, and helps regulate soil temperatures. Typically, agricultural straw or hay is mechanically applied and crimped in or wood splinters/fibers are surface applied by hand or machinery. Tackifiers may be sprayed over the applied mulch to enhance stabilization.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay		Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Typically applied as a stabilizer before or promptly following seed application;
- Can be applied to disturbed areas as a stabilization strategy when dirt work is temporarily stopped for 14 days or more;
- Material availability can impact use of this control;
- Long strand straw/hay is more effective when crimped into soil as compared to shorter strands which tend to resist crimping;
- Mulch has the potential to introduce weeds or other non-desirable species (only weed free);
- Wood splinter/fibers are inherently less susceptible to wind and water movement than other forms of mulch;
- Wood splinter bales used as sediment controls can be repurposed and spread as wood splinter mulch thus helping to reduce costs;
- Agricultural hay or straw can clog downslope inlets of other controls; and

- Works best when applied to slopes of 3:1 (H:V) or flatter, steeper slopes should consider using rolled erosion control products.

Design and Installation

- Projects adjacent to sensitive areas must use certified weed free agricultural straw or hay;
- For areas to be seeded, soil shall be prepared (with topsoil reapplied for final stabilization) and free of rocks, woody debris or soil clumps prior to mulch application;
- Straw mulch should be applied at a rate of 1.5-2 tons per acre;
- Mechanically apply straw or hay mulch over the entire area;
- Avoid creating areas of thick mulch application (over 3 in. deep) as this can impair germination of vegetation;
- Evenly apply mulch;
- Do not apply straw or hay mulch during windy conditions;
- Straw and hay mulch must be stabilized in place by crimping, application of tackifier, or netting;
- Tackifiers are suitable for small areas with gentle slopes sheltered from the wind and heavy runoff; and
- Crimpers must be capable of tucking the straw and hay mulch fibers into the soil to a depth of 3 in. without cutting the fibers.

Mulch Material	Quality Standards	Application Rates		Depth of Application	Anchoring Methods	Remarks
		Per 1000 ft2	Per Acre			
ORGANIC MULCHES						
Grass hay or cereal grain straw	Air dried, weed free. Should be at least 2/3 grass species	75-100 lb 2-3 bales	1.5-2.5 tons 90-120 bales	Lightly cover 75-90 % of the surface.	Mulch Anchoring tool or disk, wood cellulose fiber, tackifier, netting	Good to use where mulch is needed for up to 3 months. Prone to blowing if not properly disked or stabilized.
REGULAR MULCHES						
Wood Excelsior	Wood fibers 4" long	90 lb 1 bale	2 tons		Netting, Peg and Twine, Slit	Anchoring required only on critical areas or sites subjected to high winds.
Wood Splinters or Bark Shavings	Green or air dried. Hardwood species are preferred.	500-900 lb	10-20 tons	2-4"	(Optional) Netting, Peg and Twine, Slit	Recommend applying 20-25 lb Nitrogen/ton wood to prevent Nitrogen deficiency during decay. Resists wind movement.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect for areas of excessive mulch buildup or areas of minimal coverage and redistribute as required to achieve even coverage.

Mulch is biodegradable and does not require removal.

Riprap (R)

Description

Riprap is a layer of loose stone installed to stabilize and protect the underlying soils from erosion or movement. When properly sized and installed, riprap can be resistant to high velocity concentrated flows.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
	Exposed Areas		Site Perimeter
●	Inlets and Outlets		Slopes
●	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Common uses of riprap include the stabilization of cut and fill slopes, channels, inlets and outlets of culverts or other discharge structures, and slope drains;
- Slopes of 1.5:1 (H:V)or steeper may not be suitable for riprap alone as the stones may be unstable and prone to movement;
- Displacement of riprap may occur if a slope is too steep or if the installed riprap is too small;
- Typically used where erosive forces exceed the soil or vegetative covers ability to resist erosion; and
- Riprap lined channels must be designed for the installation of riprap as it reduces the flow capacity of the channel once installed.

Design and Installation

- Follow site specific or engineered designs when available;
- Riprap should be hard, durable, and not prone to breakdown when exposed to the weathering;
- Riprap can be sourced from the field or a quarry;
- Stones should be rough and angular;
- Riprap shall be a well graded mixture of stone size so that 50% by weight, shall be larger than the d50 size;
- A well graded mixture means a mixture of mostly larger stones, but with sufficient other sizes to fill in the gaps/voids between the larger stones (diameter of the largest stone size in the mixture shall be 1.5 times the d50 size and the smallest sizes shall be 1 in.);
- Minimum riprap thickness shall be 1.25 times the maximum stone diameter or 6 in, whichever is greater;
- Riprap stone size shall be selected based on the application (slope stabilization, channel stabilization, outlet protection, etc.);
- Any fill material should be compacted to a density approximating the undisturbed soils;
- The toe of the riprap should consist of larger rocks and be entrenched;
- In situations where groundwater is not an issue, a nonwoven geotextile filter fabric (type of rolled erosion control product) can be placed directly on the soil surface as a filter blanket and then covered with 3 in. of gravel;
- In situations where groundwater is an issue or if more protection is required, provide the riprap with 6 in. of granular fill underlayment covered with a nonwoven geotextile filter fabric as a drainage layer;
- When using stones of 12 in. or greater, provide a 3-4 in. deep layer of gravel (3/4 in. washed stone) to distribute the load and protect the granular fill underlayment and/or nonwoven geotextile filter fabric;
- No filter fabric should have an equivalent opening size (EOS) of less than No. 100 (intended for soils with fine-grained silts and clays) nor should the filter fabric have less than 4% open area;
- Filter fabric with EOS No. 70 is appropriate for most soils; and
- Riprap should not be layered or simply dumped into place during installation as this may cause the various stone sizes to be separated or may cause damage to the underlayment.

Slope Stabilization

- Stone size shall be selected to ensure that the natural angle of repose of the stone is less than the slope of the installation location;
- Angle of repose does not take into consideration other factors such as vibrations (adjacent to roadway); and
- Slope stabilization does not add significant resistance to slope failure and should not be used as a retaining wall or on naturally unstable soils.

Outlet Protection

See Culvert (C) and Velocity Dissipation Devices (VDD) designs for details.

Filter Blanket

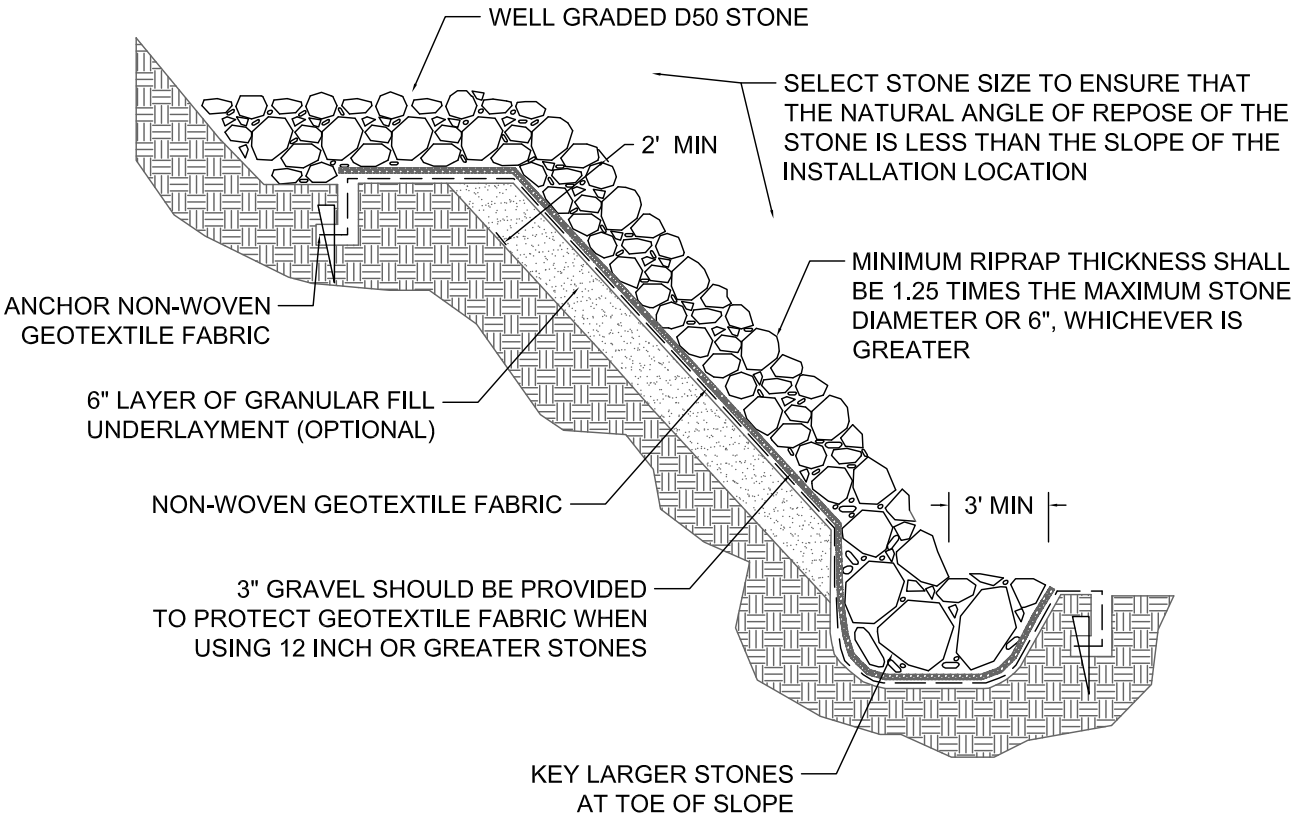
- Is a layer of material that may be placed between the underlying soil and the riprap to help prevent erosion and help support the riprap layer;
- Although not required, it is recommended that rolled erosion control products (and/or a well graded gravel or sand-gravel layer) be used as a filter blanket.
- For stabile design of a gravel filter blanket:
  - $\frac{d_{15}\ filter}{d_{85}\ base} < 5$
  - $5 < \frac{d_{15}\ filter}{d_{50}\ base} \leq 40$
  - $\frac{d_{50}\ filter}{d_{50}\ base} \leq 40$
    - Filter is the overlying material and base is the underlayment material;
    - These 3 relationships should hold between the base and filter and the filter and riprap to prevent migration of the material;
- Filter fabric thickness 20-60 mils; and
- Grab strength 90-120 lb.

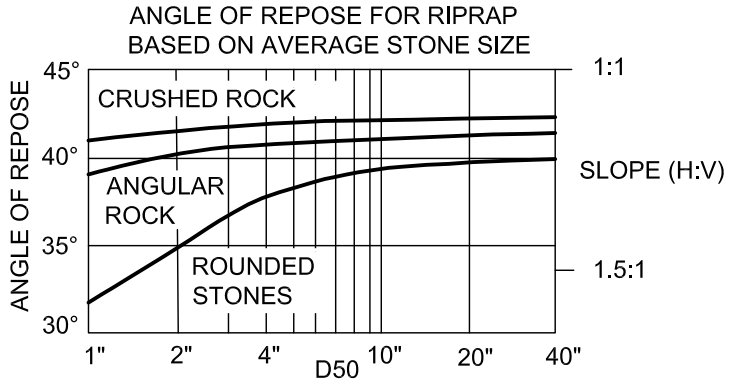
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect for stone movement, scour, or sediment buildup at toe. Repair/replace in accordance with installation instructions. Additionally, inspect for establishment of weeds/invasive vegetation and control as applicable.

Riprap is typically a long term or permanent control and does not need removed. In the event that riprap is removed, ensure all stones and synthetic filter blankets/liners are removed and that the area is stabilized with alternative controls.

RIPRAP FIGURES





Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	RIPRAP FIGURES	SHEET 1 OF 1

Sediment Basin (SB)

Description

Sediment basins are used to temporarily pond and capture eroded soil transported in storm water runoff. Sediment basins are designed to capture runoff in a large pool or pond and allow sediment to fall out of suspension prior to discharge. Sediment basins work by ponding storm water thereby dissipating enough energy for sediment to fall out of suspension. This process will only occur if storm water is retained in the pond for a sufficient amount of time.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
○	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	○	Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Typically installed at projects disturbing a minimum of 2 acres or at smaller projects near sensitive habitats;
- Sediment basins are typically not suitable for long, linear projects (see sediment traps or other applicable BMPs);
- Sediment basins work best as a final storm water control with other erosion and sediment controls installed upslope;
- Sediment basins should be installed before disturbing upslope areas; and
- Sediment basins will typically need to be designed to fit the site-specific needs and topography.

Design and Installation

Storage Volume

- Must have a minimum storage volume of 3,600 cubic per acre of drainage area;
- Minimize project run-on from undisturbed areas to avoid unnecessary storm water being directed to the sediment basin; and
- For undisturbed but stable undeveloped areas that cannot be diverted away from the sediment basin, provide a minimum of 500 cubic feet per acre of additional storage above the minimum 3,600 cubic feet per acre of disturbed area.

Geometry

- Sediment basins must be designed with a minimum length to width ratio of 2:1 (L:W) to ensure sufficient retention time of storm water;
- If a 2:1 (L:W) length is not achievable due to space limitations, baffles may be installed within the sediment pond to increase the distance between inlet and outlet points; and
- Embankment slopes should be kept to 4:1 (H:V) or flatter with no location's steeper than 3:1 (H:V).

Inlet/Outlet

- Provide energy dissipation at inflow when sediment basin receives concentrated flow;
- Extend the outlet pipe through the embankment at a minimum slope of 0.5%;
- Typical outlet design for basins treating 15 acres or less is the riser pipe;
    - Alternative outlet designs may include an orifice plate or floating skimmer which will require site specific designs;
- Provide outlet protection for all outlet flow paths;
- A riprap apron or other means of stabilization will be required when discharge velocities may cause erosion;
- Provide a stabilized emergency spillway for sediment basins; and
- Emergency spillway should be well stabilized with riprap or other stabilizing BMPs.

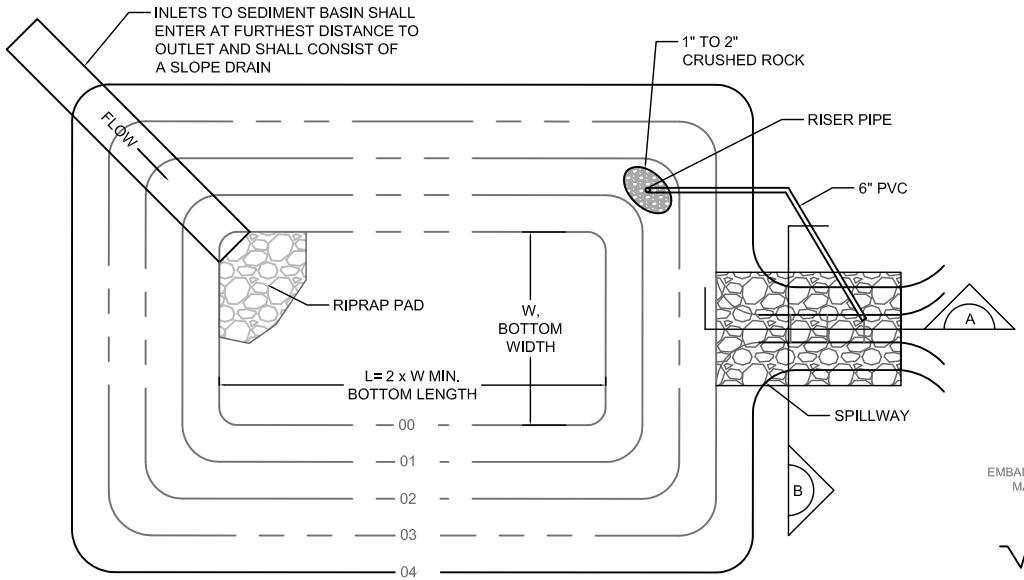
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect the sediment basin inlet and outlet for signs of erosion, debris, or sediment buildup. Inspect the embankment for signs of erosion, damage, settling, stability, and signs of seepage. Inspect the basin for sediment buildup and initiate sediment removal when the design storage volume is no more than 1/3 filled (Typically 1 ft deep for this standard design).

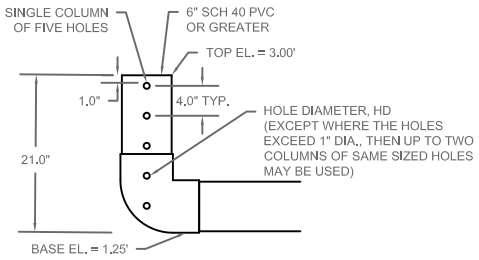
Repair all damage as soon as possible with emphasis on repairs being completed before the next precipitation event. Clean out all debris or sediment from the inlet, outlet, and basin.

Sediment basins may be a temporary or long-term BMP depending on the site-specific requirements. Sediment basins can only be removed once the upslope area has reached final stabilization or been permanently stabilized by other means. Check with local jurisdictions before removal of a sediment basin that requires dewatering as additional permits may be required. Ensure that all riprap, piping, rolled erosion control products, and other materials are removed from the location prior to filling the basin area with soil. Stabilize the reclaimed basin area with vegetation or other permanent stabilization methods.

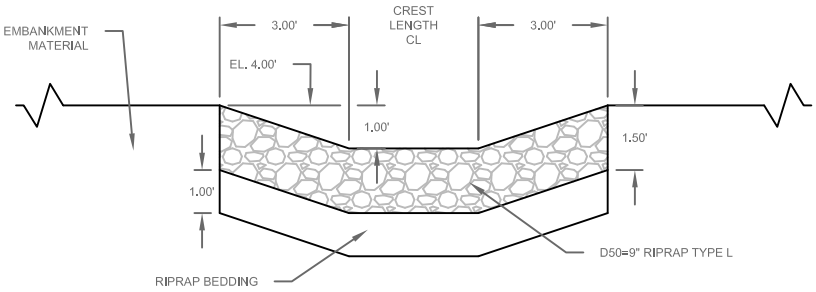
SEDIMENT BASIN FIGURES



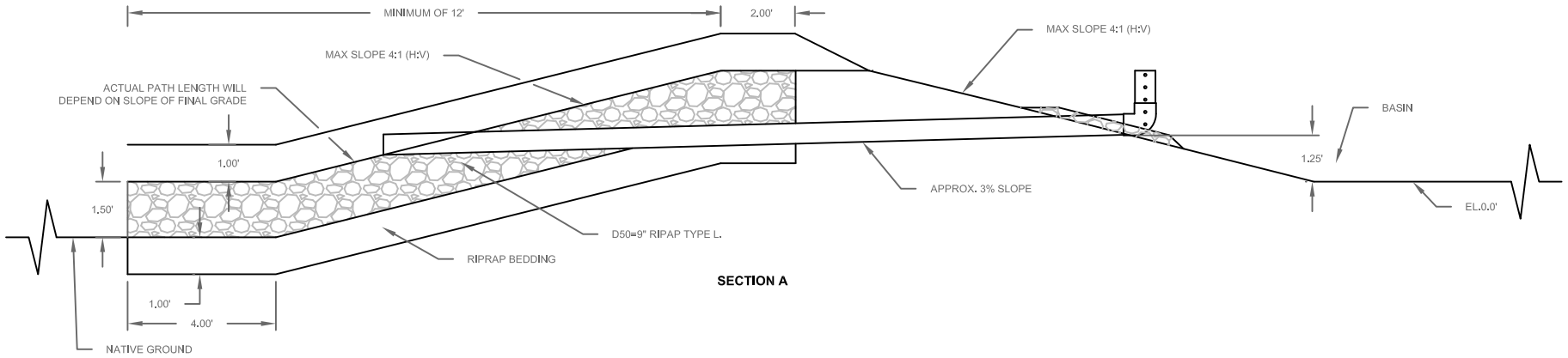
SEDIMENT BASIN PLAN



RISER PIPE



SECTION B



SECTION A

SEDIMENT BASIN FIGURES

SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
UPSTREAM DRAINAGE AREA (ROUNDED TO NEAREST ACRE), (AC)	BASIN BOTTOM WIDTH (W), (FT)	SPILLWAY CREST LENGTH (CL), (FT)	HOLE DIAMETER (HD), (IN)
1	12 1/2	2	9/32
2	21	3	13/16
3	28	5	1/2
4	33 1/2	6	9/16
5	38 1/2	8	21/32
6	43	9	21/32
7	47 1/4	11	25/32
8	51	12	27/32
9	55	13	7/8
10	58 1/4	15	15/16
11	61	16	31/32
12	64	18	1
13	67 1/2	19	1 1/16
14	70 1/2	21	1 1/8
15	73 1/4	22	1 3/16

IMPERVIOUSNESS (%)	ADDITIONAL STORAGE VOLUME (FT^3) PER ACRE OF TRIBUTARY AREA
UNDEVELOPED	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

1. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.
2. SEDIMENT BASIN SHALL BE INSTALLED PRIOR TO ANY OTHER LAND-DISTURBING ACTIVITY THAT RELIES ON BASINS AS A STORM WATER CONTROL.
3. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING A NO. 200 SIEVE.
4. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.
5. PIPE SCH 40 OR GREATER SHALL BE USED.
6. THE DETAILS SHOWN PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. INDIVIDUAL SITE SPECIFIC DESIGNS ARE REQUIRED FOR ALL SEDIMENT BASINS DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.
7. CHECK LOCAL JURISDICTIONS FOR BMP DETAILS THAT VARY FROM THIS DESIGN.

Sediment Trap (ST)

Description

Sediment traps are temporary sediment control BMPs constructed by excavating a depression or by placing an earthen berm across a low area or drainage swale. Sediment traps slow and temporarily detain sediment laden runoff. The reduction in velocity (energy) allows sediment to fall out of suspension and collect in the sediment trap before the runoff is discharged into a stabilized area. This process will only occur if storm water is retained in the trap for a sufficient amount of time.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
○	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions	○	Pollution/Material Sources
●	Ditches	●	Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Sediment traps should be installed before disturbance of upslope areas;
- Use sediment traps in areas of concentrated flow or at discharge points;
- Sediment traps may require frequent cleanout and/or maintenance;
- Should only be used to control sediment from small drainage areas (typically less than 1 acre);
- Sediment traps can be combined with other sediment traps in series to increase effectiveness;
- Sediment traps can be used with other sediment control measures to increase effectiveness; and
- Sediment traps are not as effective at settling fine particles, such as clay or silt, compared to heavier particles like sand.

Design and Installation

- Excavate a depression or install a berm to construct a detention area;

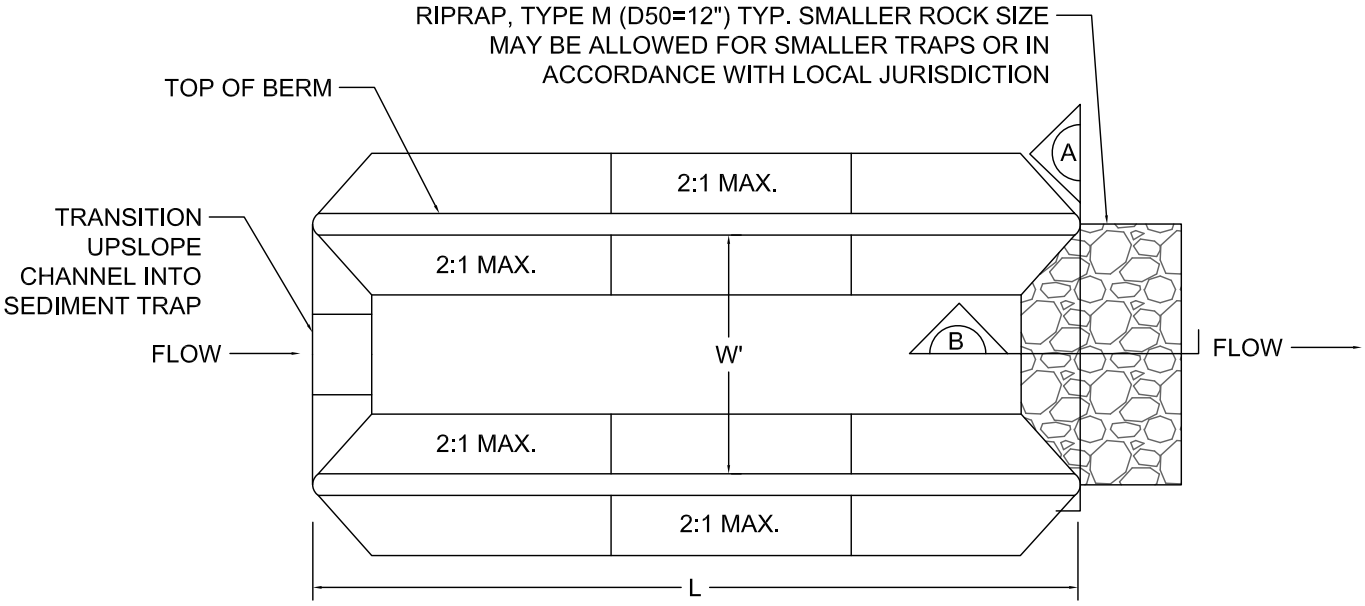
- Sediment traps are most effective when the length is greater than the width (optimal size is L ≥ 2 x W);
- Compact berms to 95% of the maximum density;
- Depression walls or berms shall have maximum slopes of 2:1 (H:V);
- Provide a stabilized outlet using riprap or other stabilization controls;
- If using riprap for outlet stabilization; see the riprap specification for details;
- Typical riprap size for sediment trap outlets is D50 = 12 in.;
- Construct the top of the earthen berm so that it is a minimum of 6 in. higher than the top of the riprap outlet; and
- Construct the ends of the riprap outlet structure so that they are a minimum of 6 in. higher than the outlet structure center.

Maintenance and Removal

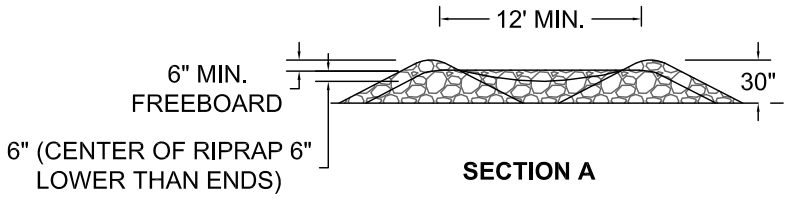
Inspections should be conducted in accordance with the Storm Water Plan. Inspect sediment traps for damage or failure and for sediment and debris buildup. Sediment traps need to be cleaned out when sediment has built up to 1/2 of the height of the riprap outlet.

Sediment traps are temporary and shall be removed when the upslope disturbed areas are stabilized with vegetation or other permanent stabilization measures. Ensure that all riprap, rolled erosion control products, and other materials are removed from the location prior to filling the sediment trap depression or spreading the earthen berm. Stabilize the reclaimed basin area with vegetation or other permanent stabilization methods.

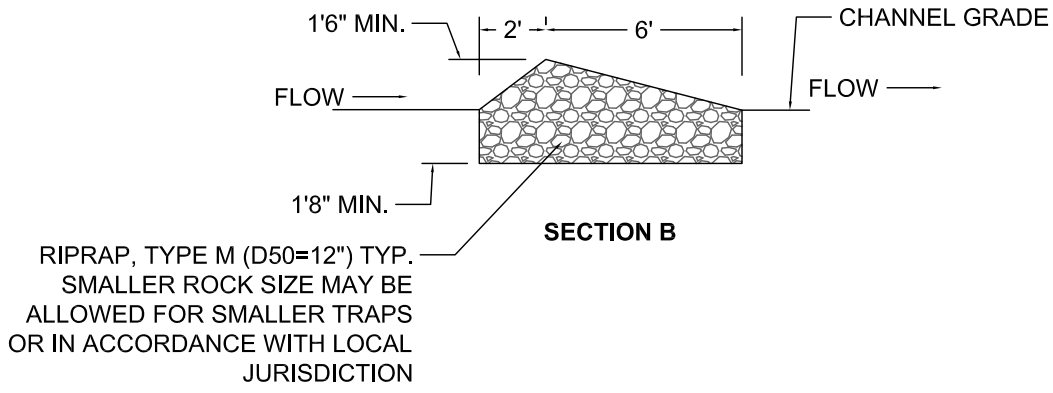
SEDIMENT TRAP FIGURES



SEDIMENT TRAP PLAN



SECTION A



SECTION B

Seeding (S)

Description

Seeding, to establish perennial vegetative cover following construction, is the best long term stabilization control for areas not stabilized with other permanent controls (pavement, concrete, road base, etc.). Establishing perennial vegetation stabilizes the soil, reduces wind and water erosion, minimizes sheet flow, increases infiltration, and reduces overall runoff volumes.

Seeding can be used to establish temporary stabilization when dirt moving activities have ceased and will not resume for an extended period of time (30 days or longer). Typically, a quick growing annual cover crop will be planted, provided that the time of year is conducive to germination and growth.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
●	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets	●	Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay	○	Rocky Subgrade
○	Sand		
●	Loam		

Selection Considerations

- Seeding must be combined with other temporary stabilization BMPs to prevent erosion while waiting for vegetation germination and maturation;
- Select a seed mix (species and seeding rates) that is applicable to the climate, region, and site-specific soils;
- Seeding for permanent stabilization must be applied only after all dirt work is complete and topsoil has been redistributed;
- Soil amendments may be required on a site-specific basis;
- Planting technique can greatly impact success of seed germination;
- Seeding is typically combined with mulch or rolled erosion control products; and

- Topsoil must be properly conserved, handled, and stored for use in reclamation.

Design and Installation

- Ensure all grading, soil preparation, topsoil distribution (permanent seeding only), and amendment applications are complete before seeding;
- If soil quality is a concern, soil testing may be beneficial to identify limiting factors and recommend amendments;
- The ground surface should be rough and firm, but not compacted or too loose (rip or roto-till if needed);
- Seed to soil contact is vital for germination;
- Ensure that poor quality subsoils are not mixed with topsoil during dirt work;
- Select native and/or desirable species based on preexisting or background vegetation communities and/or in accordance with landowner or jurisdictional requirements;
- Ensure the seed mix has a combination of warm and cool season species;
- Drill seeding is the preferred method but hydroseeding or hand seeding can be used where steep slopes prevent use of drill seeding equipment;
- If hand seeding or broadcast seeding, application rates should be doubled;
- Seeding for final stabilization should commence within 14 days following construction completion, provided that seasonal conditions are favorable (e.g. ground is not frozen, not in the dry, hot part of summer, etc.);
- Seeding is most effective when conducted in the spring, between late March and mid-May, and in the fall, between early September and when the ground freezes; and
- Cover seeded areas with mulch (can be applied before seeding) or other temporary stabilization BMPs to prevent erosion while waiting for vegetation germination and maturation.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect seeded areas for erosion, soil impacts (vehicle traffic or disturbance), and the condition of associated BMPs. Implement repairs or install additional temporary BMPs as needed to stabilize the areas until vegetation can be established. Inspect seeded areas for even germination and vegetative health following the first growing season. Spot seed and/or add additional mulch as identified by inspections. Monitor seeded areas for invasive, noxious, or other undesirable species of vegetation and implement mechanical or chemical controls as necessary to control.

Typically, it only takes one growing season for seed to germinate and establish an even cover. Yearly variations in precipitation and temperature can influence the results and should be considered when evaluating reclamation success. Areas of poor or no growth may require reseeding.

Once vegetation is well established, the associated temporary BMPs can be removed if applicable.

Silt Fence (SF)

Description

Silt fence is a temporary sediment control designed to intercept storm water runoff from disturbed areas. Silt fence works by ponding storm water which allows sediment to fall from suspension. Silt fence is typically constructed of a woven geotextile fabric attached to or stretched across supporting stakes. The fabric is trenched into the ground to prevent water from bypassing the control.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay		Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- The effective lifespan is between 5 and 8 months;
- Should be installed down gradient of disturbed areas;
- Can be installed as perimeter control for the construction project or for receiving waters;
- Can be installed around temporary stockpiles;
- Can be installed at the toe of exposed slopes prone to erosion;
- Not intended for intercepting concentrated flows or as flow diversion;
- Does not work in areas of continuous ponding;
- Has an increased risk of failure/damage when installed in high wind areas; and
- Should not be used as mid slope protection when slopes are steeper than 4:1 (H:V).

Design and Installation

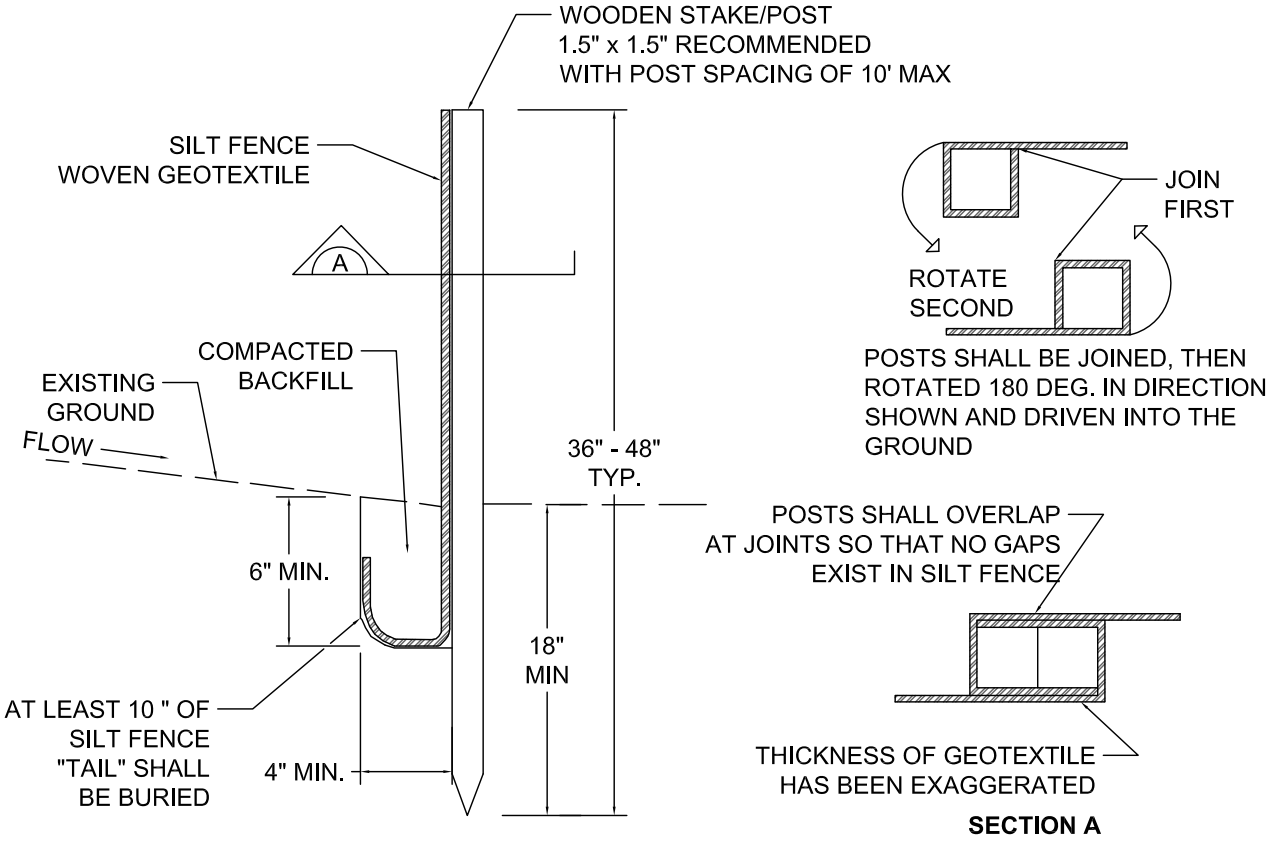
- Works best when installed on relatively flat terrain or when installed on contour (perpendicular to flow) to intercept sheet flows;
- The typical maximum allowable tributary area is 0.25 acre with up to 150 ft of disturbed slope (no steeper than 3:1 (H:V)) for every 100 linear feet of silt fence installed;
- When used as perimeter control or other similar use, install in a manner that will minimize concentrated flows (e.g. J-hook ends);
- Reinforced silt fence with wire backing may be selected where site conditions necessitate increased durability and strength (areas with rock or heavy soil dislodgement);
- Storm water flows reaching the silt fence should be limited to 0.5 cubic feet per linear foot or less;
- Ensure proper stake/pole spacing;
- Silt fence must be trenched with no gaps between the fabric and the ground;
- Anchor fabric at least 6 in. deep in the ground;
- When used at the toe of a slope, place 5-10 ft beyond the toe of the slope to allow room for ponding behind the control; and
- Avoid runs of silt fence greater than 500 ft in length.

Maintenance and Removal

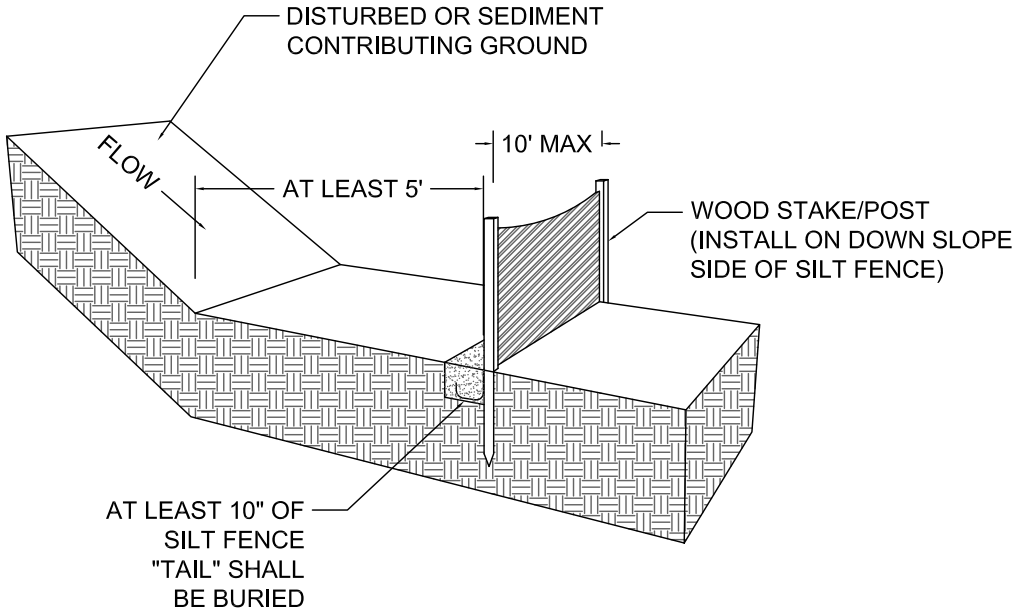
Inspections should be conducted in accordance with the Storm Water Plan. Inspect silt fence for damage (tears/holes), slumping, undercutting, bypass, and sediment buildup. When silt fence is damaged, the damaged section typically requires replacement. As sediment builds up along the silt fence, it needs to be removed before it reaches 6 in. or greater in depth.

Silt fence may be removed once the upslope area has been stabilized with vegetation or other control measures. Ensure all removed silt fence is disposed of appropriately.

SILT FENCE FIGURES



SILT FENCE



Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	SILT FENCE FIGURES	SHEET 1 OF 1

Surface Roughening (SR)

Description

Surface roughening is a temporary stabilization method designed to minimize erosion by reducing runoff velocity, decreasing wind exposure, increasing infiltration, and to a minor extent, trapping sediment. Surface roughening is typically installed on steep slopes and implemented using tracked equipment or equipment capable of scarifying or tilling exposed soils to create variations in the surface.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
	Inlets and Outlets	●	Slopes
	Near Water/Wetlands	●	Toe of Slopes

Soils

●	Clay		Rocky Subgrade
	Sand		
●	Loam		

Selection Considerations

- Surface roughening is a temporary erosion control measure and may require frequent reapplication;
- Surface roughening may be effective for up to 30 days, provided a major rain event or series of minor rain events have not reduced functionality;
- Installation requires heavy machinery (which makes reapplication difficult if heavy machinery is removed from location);
- Tracking using heavy machinery will result in soil compaction and therefore should not be used on topsoil or areas planned for vegetation establishment;
- Tilling, ripping, or similar techniques are better surface roughening options for topsoil or areas planned for vegetation establishment;
- Surface roughening is intended to be used in conjunction with other erosion and sediment control BMPs; and

- Surface roughening is not effective on sandy soils and alternative stabilization methods should be implemented.

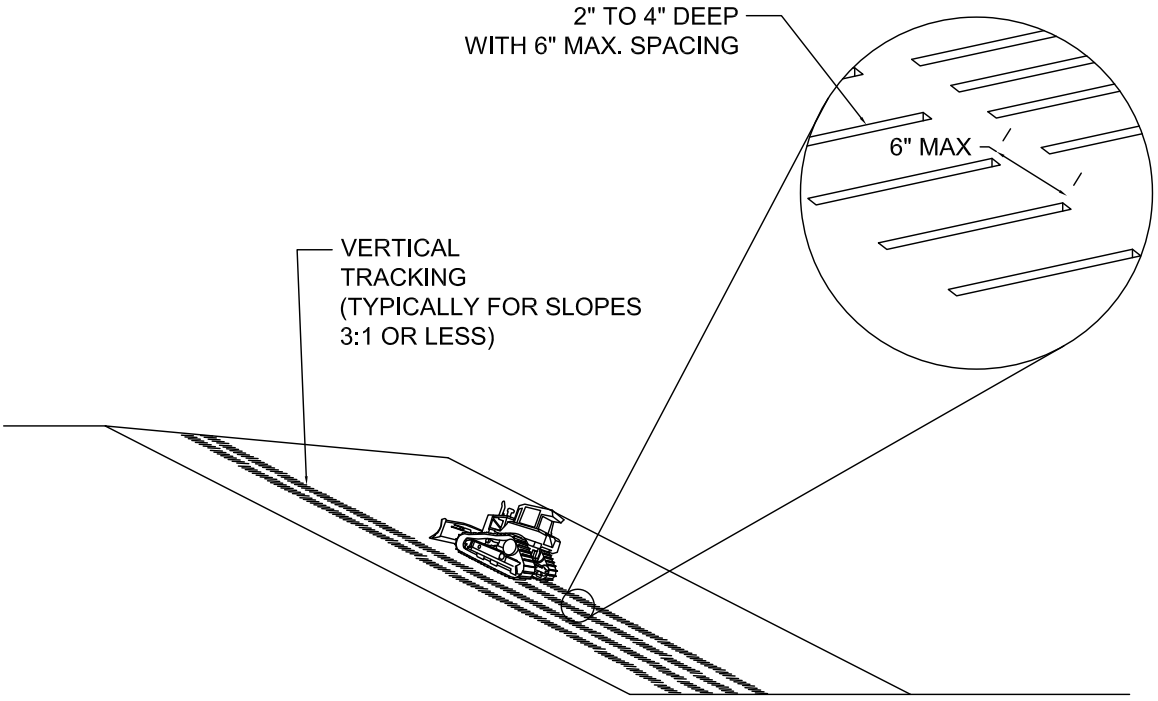
Design and Installation

- Install surface roughening as temporary stabilization in active construction areas that will remain inactive for a short period of time or after final grading;
- Surface roughening should create impressions or channels that are 2-6 in. deep and approximately 6 in. spacing; and
- Impressions or channels should run perpendicular to the slope (flow of water).

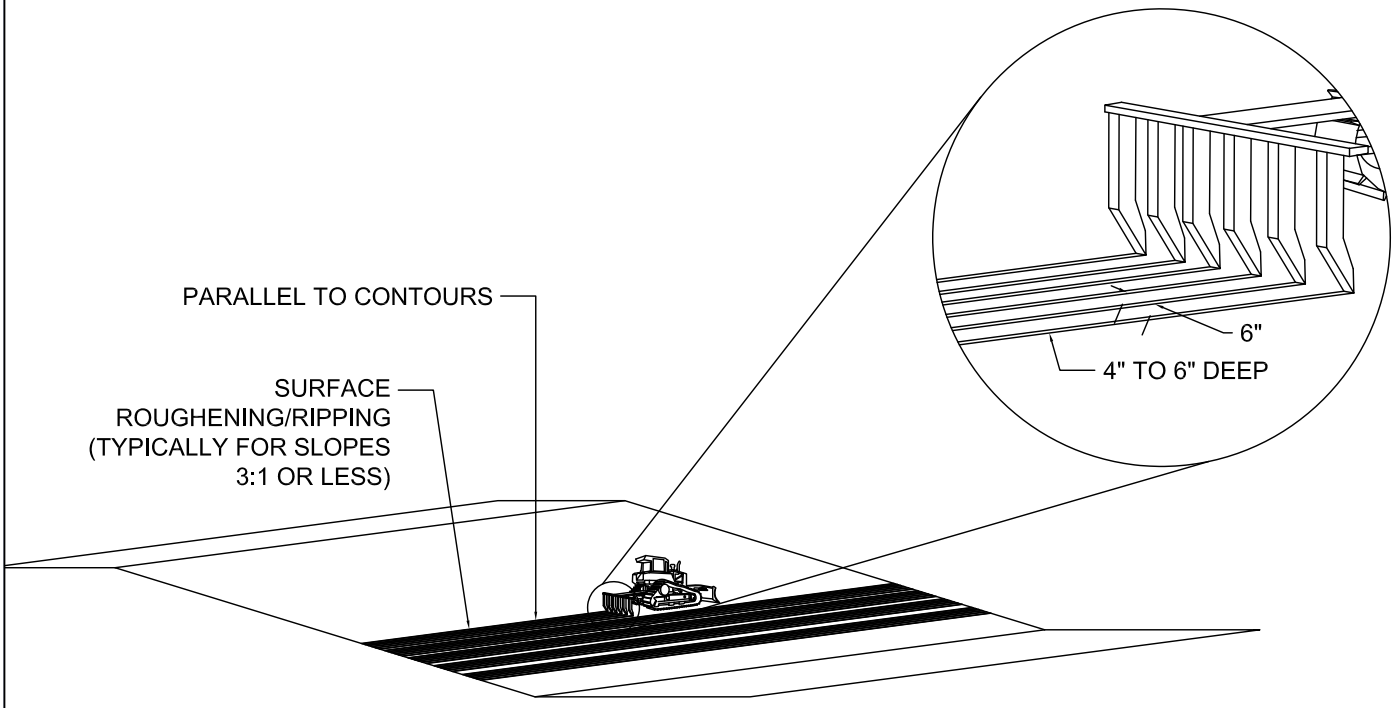
Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect surface roughening for signs of smoothing, erosion, or impacts from vehicles. Wind and precipitation events will smooth out the roughened surface reducing effectiveness. If no longer effective, reapplication or alternative stabilization methods may need to be implemented.

SURFACE ROUGHENING FIGURES



SURFACE ROUGHENING



Compiled by H2E, Inc.	Updated: 12/2020	Not to Scale	SURFACE ROUGHENING FIGURES	SHEET 1 OF 1

Stockpile Management (SP)

Description

Stockpile management is the protection of stockpiled erodible materials through structural and nonstructural practices.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

●	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
●	Near Water/Wetlands	●	Toe of Slopes

Soils

○	Clay	○	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Stockpiles of erodible materials should be located away from drainages, waterways, or other sensitive areas;
- Stockpile management typically requires the use of multiple erosion and sediment control BMPs;
- Requires a combination of stabilization and sediment control practices;
- Avoid stockpiling contaminated soils on location when possible; and
- The anticipated storage timeframe will typically dictate the selected stockpile management practices.

Design and Installation

- Locate stockpiles in areas that will remain largely undisturbed or in areas that work best in the phasing of construction;
- Recommend installing perimeter sediment controls (e.g. silt fence, wattles, etc.) around stockpiles, although not required when stockpiles are located on the interior of the construction project and where other down slope sediment controls are installed;

- Perimeter sediment controls should be installed 5-10 ft off the toe of the stockpile (do not install directly next to stockpile);
- If soils will be stockpiled less than 30 days, recommend surface roughening the stockpile (reapply as needed);
- If soils will be stockpiled between 30 and 60 days, recommend surface roughening and/or mulching the stockpile;
- If soils will be stockpiled longer than 60 days, recommend using seed and mulch, rolled erosion control products, or similar stabilization methods;
- If stockpiling contaminated soils, install a perimeter berm/dike around the stockpile;
- Installation of a liner may be required for stockpiling of contaminated soils depending on the type of contaminate; and
- Recommend installing signage to indicate material type, especially for topsoil storage.

Maintenance and Removal

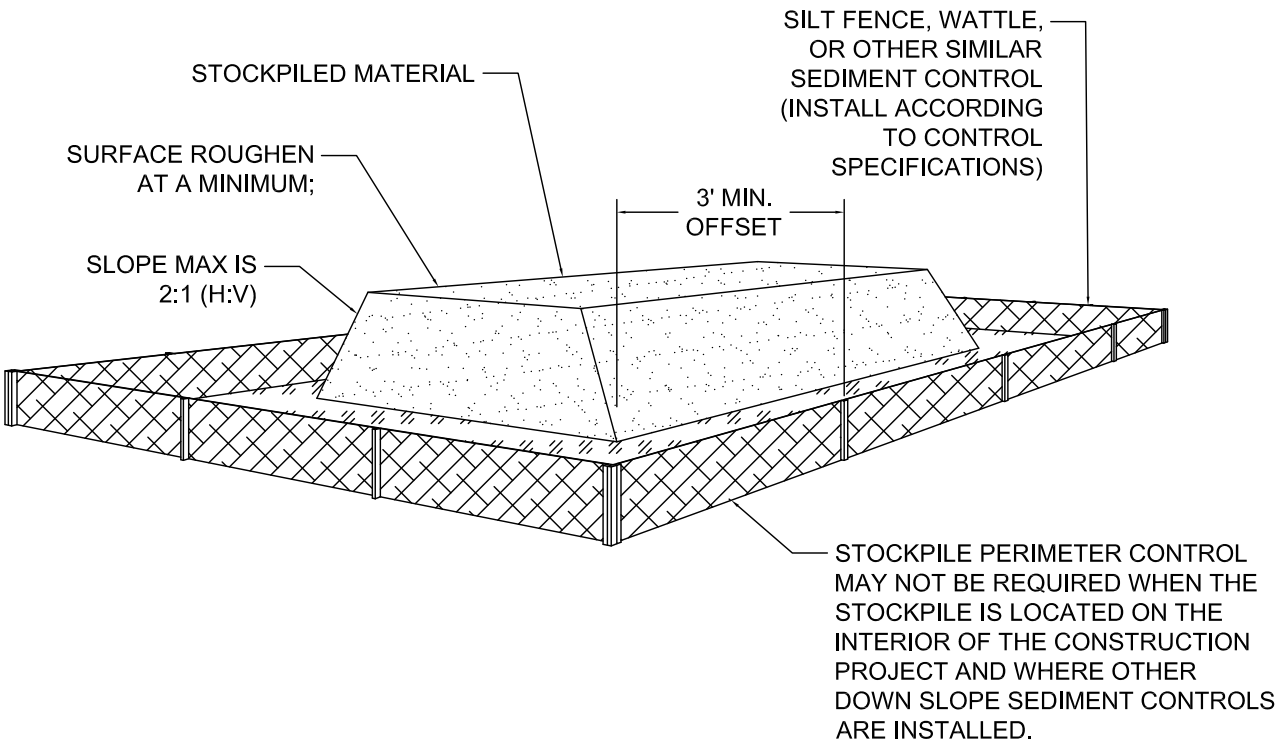
Inspections should be conducted in accordance with the Storm Water Plan. Inspect stockpiles for signs of erosion and sediment buildup along perimeter sediment controls. Signs of erosion indicate additional stabilization methods may be needed, especially in longer term storage applications. Recover sediment build up from perimeter controls and return to stockpile.

If using vegetation or other long term stabilization methods, inspect for function and repair or maintain as outlined in the installation details.

If temporary removal of the perimeter controls is required for access, ensure proper reinstallation once access is complete.

Once the stockpile is no longer required, remove or disperse excess material. Areas where stockpiles are removed should be stabilized with vegetation or other permanent stabilization methods.

STOCKPILE MANAGEMENT FIGURES



IN ADDITION TO PERIMETER SEDIMENT CONTROLS, IT IS RECOMMENDED THE FOLLOWING BE APPLIED:

1. IF SOILS WILL BE STOCKPILED LESS THAN 30 DAYS, RECOMMEND SURFACE ROUGHENING THE STOCKPILE (REAPPLY AS NEEDED).
2. IF SOILS WILL BE STOCKPILED BETWEEN 30 AND 60 DAYS, RECOMMEND SURFACE ROUGHENING AND/OR MULCHING THE STOCKPILE.
3. IF SOILS WILL BE STOCKPILED FOR MORE THAN 60 DAYS, RECOMMEND USING SEED AND MULCH, ROLLED EROSION CONTROL PRODUCTS, OR SIMILAR STABILIZATION METHODS.

Surface Armor (SA)

Description

Surface armor is a combination of various materials (e.g. clay, concrete, dirt, rock, etc.) used to stabilize a surface on location where erosion could occur. The armor reduces erosion caused by runoff and/or raindrop impact, and provides a stable working surface for various construction related activities. Surface armor is often utilized throughout the life of a location and can be incorporated on access roads, tank battery locations, and well head locations.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Surface armor is applicable to all construction locations (excluding plugged & abandoned and final reclamation locations where material is removed). Armoring material is appropriate in areas where all aspects of construction and vehicular traffic are expected, as well as areas where long term surface stabilization is required and vegetation cannot be used. Surface armor is not designed to control and/or manage concentrated storm water runoff and should not be used as a filtering media.

Selection Considerations

Materials utilized for surface armor may be limited or ineffective on slopes greater than 3:1 (H:V). Scraping/re-contouring and/or removal of snow may affect functionality and unwanted distribution of surface armor materials. Some other concerns with surface armor are compaction and tilling, which warrants a refreshing of the material and/or additional applications, and the possibility of material being tracked off-site following a significant precipitation or melting event.

Design and Installation

Locations are generally designed for the use of:

- Class 5 road base; or
- Class 5 road base with 10% Portland cement mix (typically around well heads and areas where additional stabilization is needed).

Surface armor use and type can vary between phases at a given location.

Construction Phase

During the construction phase, surface armor will be applied intermittently and where applicable. This includes, but is not limited to, the working surface of a location, access roads, and any relating surfaces requiring a means of stabilization in the event that construction and vehicular traffic is anticipated.

Drilling Phase

Drilling specific surface armor will be applied to the area(s) around the well heads. A mixture of concrete, generally 10% Portland mix and road base material, will be used to create an apron around the wells and serve as both a stabilization method and additional support for a drilling rig. The concrete apron also serves as dust mitigation, vehicle tracking control, and sediment pollution control, as the area is solidified upon installation of the apron.

Completions Phase

Surface armor during the completions phase will consist of road base throughout the location and any additional stabilization material required for equipment and vehicular traffic.

Interim Phase

Once all construction related activities are complete on location (e.g., drilling, completions, etc.), road base will be applied throughout to serve as surface armor during the expected life of the location. Road base will be applied to working areas around the tank battery and well heads, as well as the access road where applicable. Generally, the location undergoes a pullback and reduction phase, also known as interim reclamation, after which road base will be applied and periodically maintained and/or re-applied as necessary. Concrete aprons around the well heads are expected to remain around the well heads throughout the life of the location.

Maintenance and Removal

The frequency of inspections should be in accordance with the Storm Water Plan. Inspect all surface armor to ensure there are no erosional issues or off-site movement as it relates to day-to-day operations. All erosional issues shall be addressed with equipment and/or additional armoring material as needed. If off-site deposition is discovered, recovery of all material shall be conducted immediately. Maintenance activities including grading and/or snow removal have the potential to impact the surface armor. Care shall be taken to minimize the impacts to existing surface armor during other maintenance activities. If surface armor effectiveness is reduced, additional applications of surface armor material may be required.

Remove surface armor from areas anticipated to be reclaimed and or turned back to agricultural practices as necessary. In the event of pad reduction/reclamation, follow all final reclamation practices as described in the SWMP.

Vehicle Tracking Control/Tracking Pad (VTC/TP)

Description

Vehicle tracking control (tracking pad) is a temporary stabilized entrance to the construction location that helps minimize off-site tracking of sediment onto public roads. Tracking pads help remove sediment from vehicles by providing a stabilized area where sediment can be tracked, shaken, and/or washed off before leaving the location.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

	Erosion Control		Good Housekeeping
●	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas	●	Site Perimeter
	Inlets and Outlets		Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay	●	Rocky Subgrade
●	Sand		
●	Loam		

Selection Considerations

- Tracking pads should be installed at each construction site entrance/exit to a paved public road or other road of concern;
- Tracking pads are particularly important during wet periods when tracking of sediment is increased;
- Tracking pads help reduce traffic dust during dry weather;
- A properly installed tracking pad will reduce the likelihood of ruts forming near the entrance; and
- May require periodic street sweeping to control fines that track onto paved roadways.

Design and Installation

- When selecting a location to install a track pad, site grades, sight distances, and curves on public roads must be considered for safe placement;
- Consider the turning radius of construction vehicles when installing a tracking pad;

- If storm water flows towards a track pad, use berms/dikes, ditches or other storm water routing controls to redirect flows away from the track pad;
- Construction fence, silt fence or other visual indicators may be required to ensure vehicle traffic does not bypass the tracking pad when entering or exiting the construction site;
- If required, install signage to indicate entrance/exit locations and direct traffic;
- A non-woven geotextile fabric is recommended between the trackpad aggregate and the compacted subgrade;
- The tracking pad area will need to be excavated approximately 9 in. to ensure level grade with the public road once aggregate is installed (except when using construction, woven, or reinforcement mats); and
- If using pre-fabricated vehicle tracking pads, follow all manufacturer specifications.

Vehicle Tracking Control with Wheel Wash

- If using equipment to wash wheels and wheel wells prior to vehicles entering the public road, ensure that all state and local rules and permitting requirements are followed;
- Recommend using only clean wash water;
- Soaps and other wash chemical may require additional permitting;
- Install a ditch to direct wash water away from the tracking pad and into a sediment control device; and
- Retention of wash waters on location may be required by state, county or local jurisdictions.

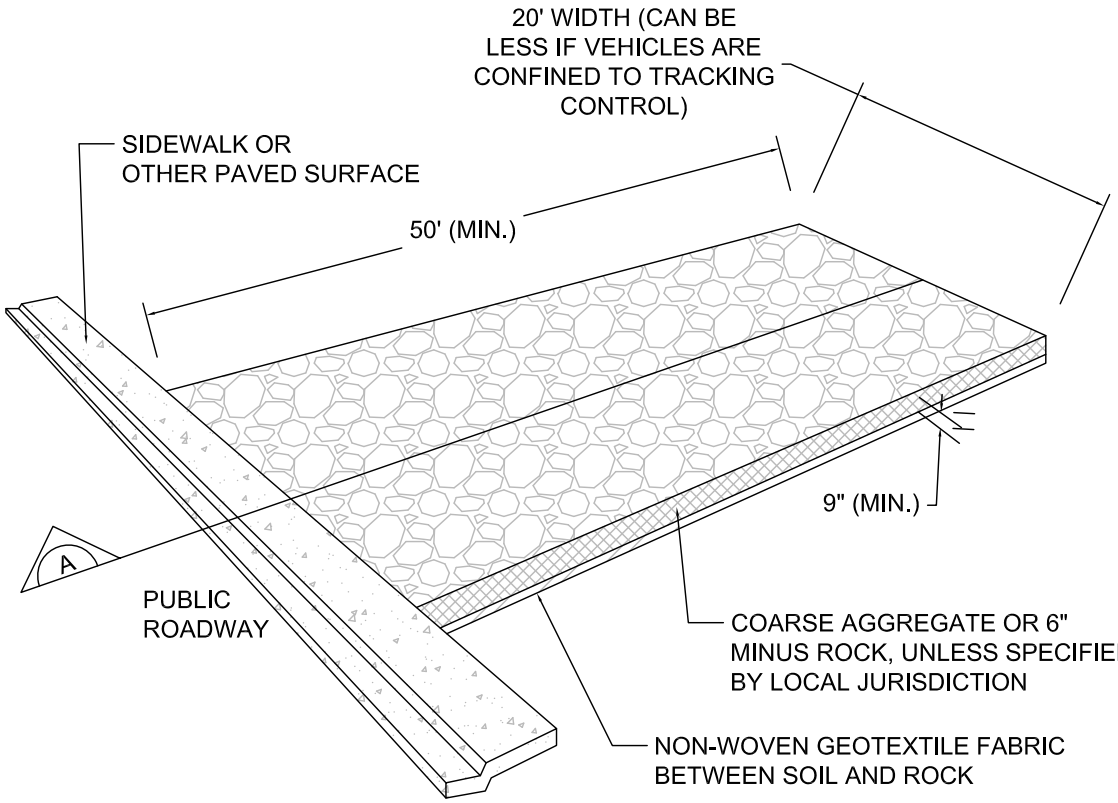
Maintenance and Removal

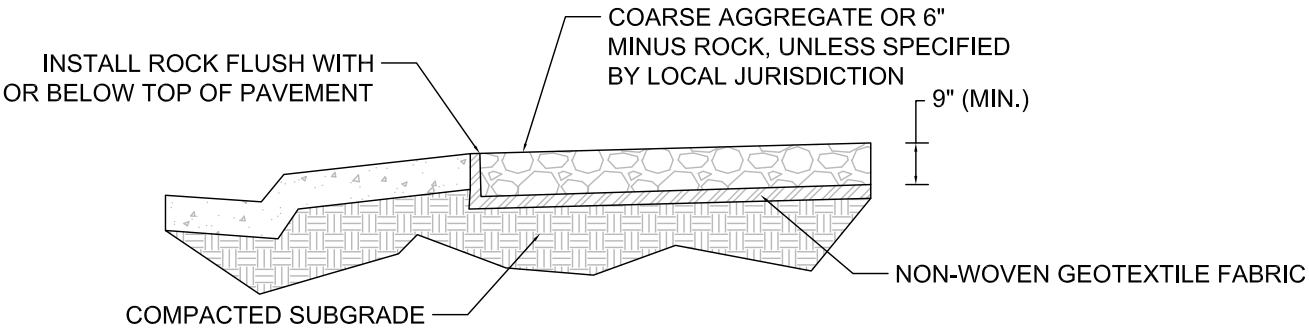
Inspections should be conducted in accordance with the Storm Water Plan. Inspect tracking pads for sediment buildup on/in the tracking pad. If sediment build up has occurred, cleanup and refreshing of the track pad may be required. Also, inspect for damage to the tracking pad or underlayment. Maintain or repair in accordance with installation design. Inspect roadway for sediment tracking and initiate street sweeping when required.

The use of pre-fabricated tracking pads may require more frequent maintenance than aggregate based tracking pads.

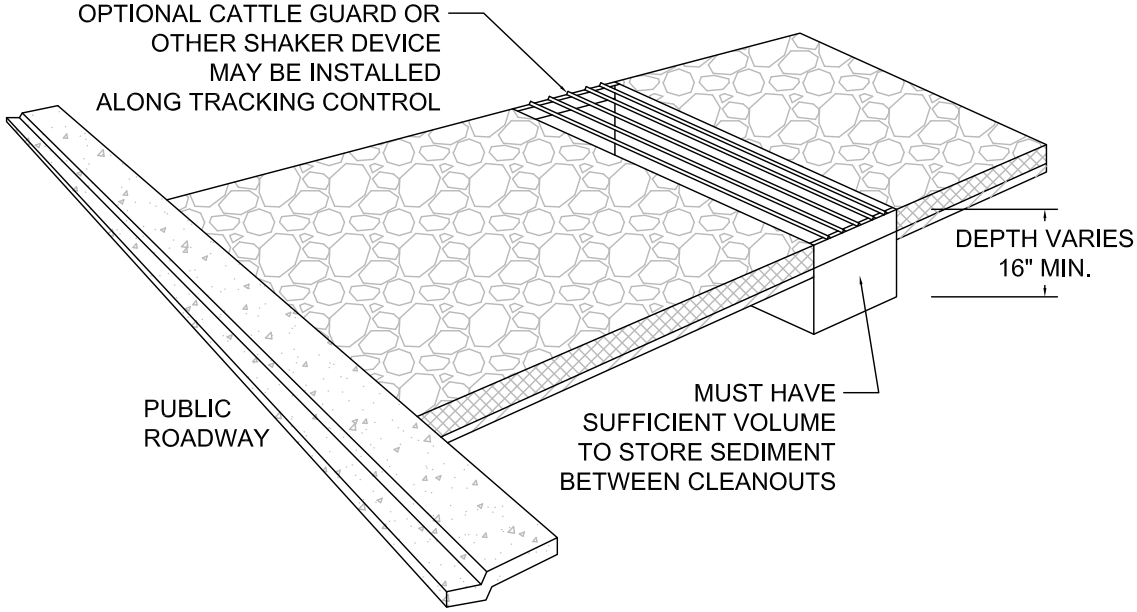
Vehicle tracking pads should only be removed once the site is stabilized and the risk of off-site tracking is eliminated. The aggregate may be washed and repurposed on location or removed from location and recycled. Ensure that all liner material is removed and properly disposed of at an approved facility. Regrade the excavated area and stabilize with vegetation or other permanent stabilization methods.

VEHICLE TRACKING CONTROL FIGURES

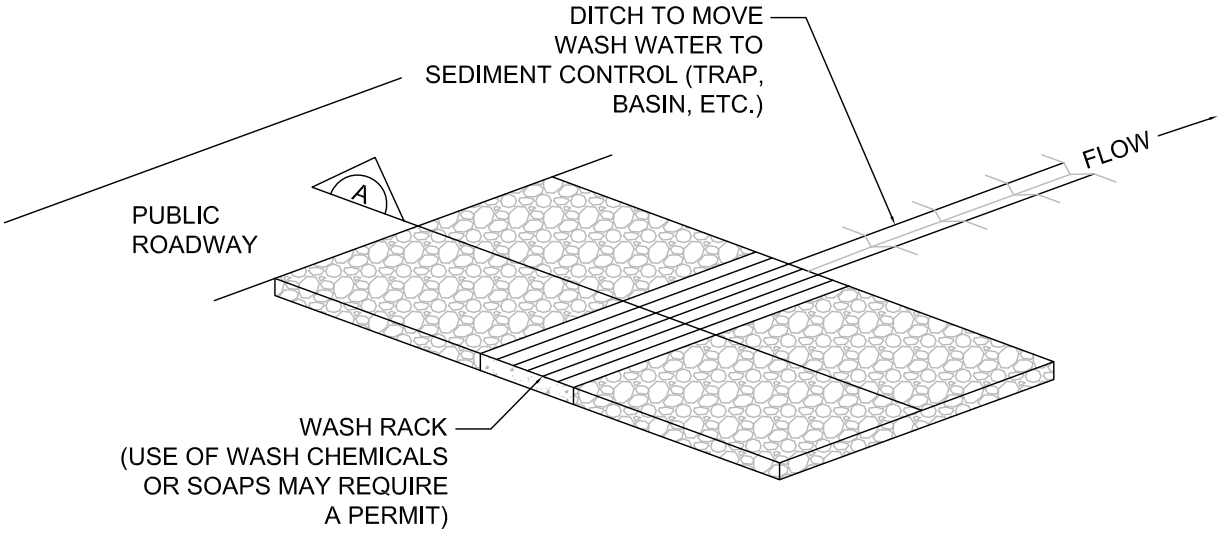


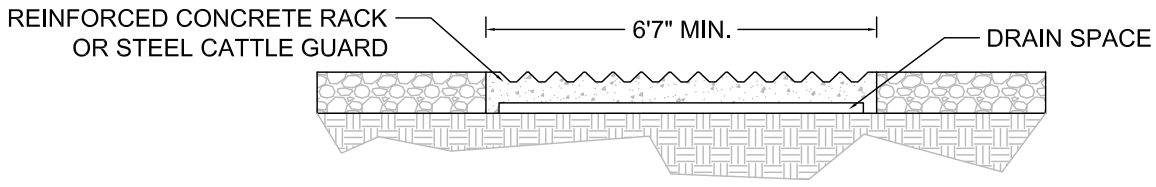


SECTION A



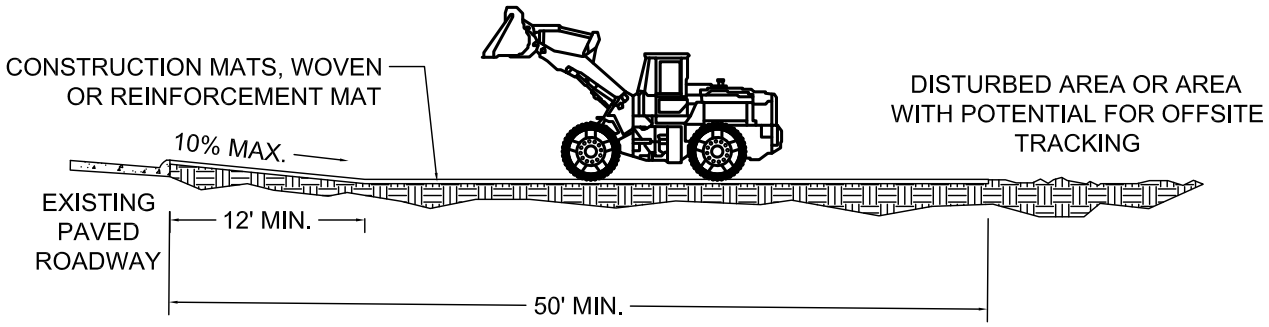
VEHICLE TRACKING CONTROL FIGURES

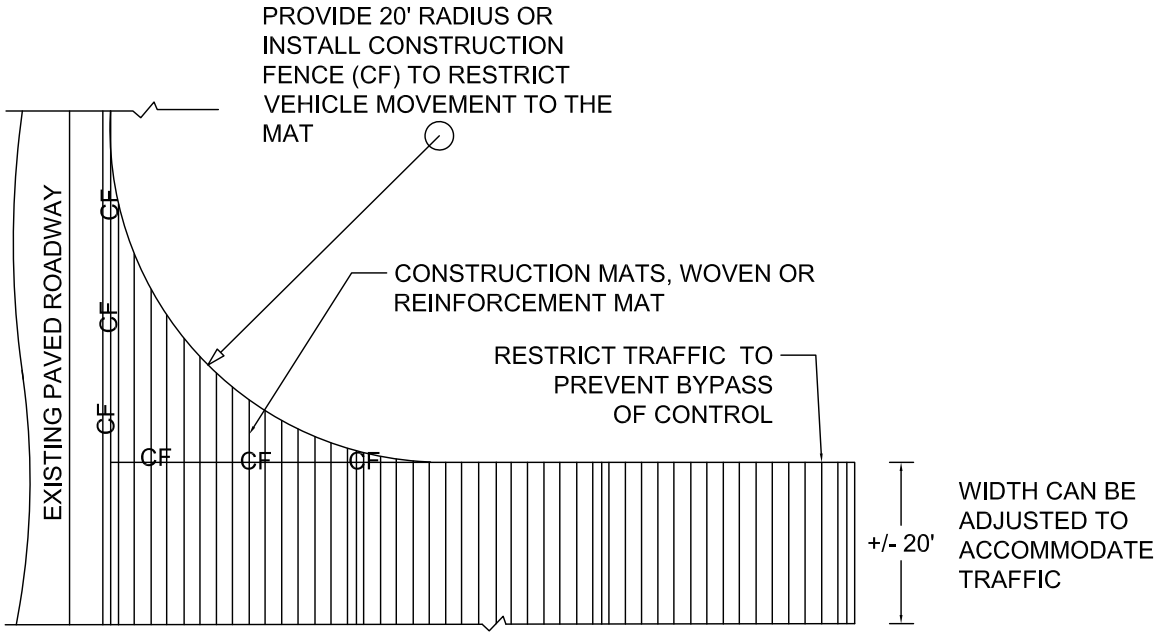




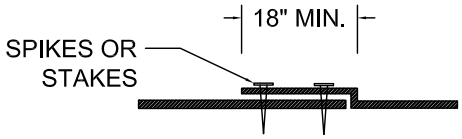
SECTION A

VEHICLE TRACKING CONTROL FIGURES





CONSTRUCTION MAT END OVERLAP INTERLOCK WITH STRAP CONNECTORS



REINFORCED MAT

Water Bar (WB)

Description

Water bars are a temporary or permanent control designed to effectively shorten uninterrupted flow paths into shorter sections and direct flows into stable well vegetated areas. Water bars are typically constructed of berms or berms with swales installed diagonally across linear disturbances. Water bars are generally used on narrow, linear projects such as a utility right-of-way or pipeline.

Uses

● Meets full use/application; ○ meets use/application under certain circumstances; and no symbol indicates not appropriate/applicable.

●	Erosion Control		Good Housekeeping
○	Sediment Control		Snow Management
	Chemical/Pollutant Control		

Applications

	Cut/Fill Transitions		Pollution/Material Sources
	Ditches		Sediment Traps/Basins
●	Exposed Areas		Site Perimeter
	Inlets and Outlets	●	Slopes
	Near Water/Wetlands		Toe of Slopes

Soils

●	Clay		Rocky Subgrade
	Sand		
●	Loam		

Selection Considerations

- Install on long, narrow (typically 100 ft wide or less) continuous slopes susceptible to erosion;
- Can be installed on grades ranging from 2% to over 20%; and
- Water bars are not typically effective on sandy soils or rocky subgrade.

Design and Installation

- Water bars shall be installed perpendicular to the slope;
- A slope of 2% or less (crossing angle of 60 degrees is preferred) shall be applied to the water bar (swale and berm) in order for storm water to flow across the control and into an adjacent well vegetated area;
- Water bars shall have an installed height (from the swale bottom to the berm top) of at least 12 in.;
- The typical water bar width shall be between 6 ft and 12 ft;
- The berm is typically constructed using the excavated swale material;

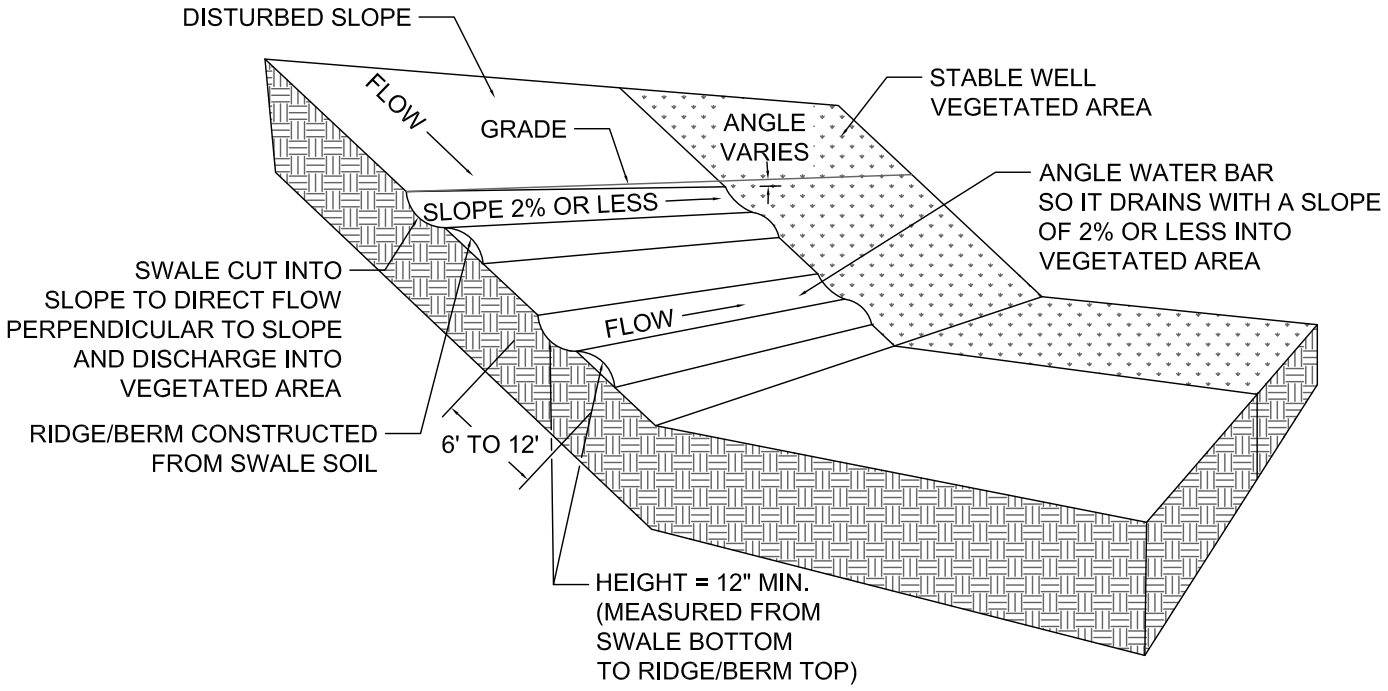
- The berm must be compacted;
- Space water bars according to the slope and the soils susceptibility to erosion (a minimum and maximum spacing is provided); and
- Optional stabilized outlets may be installed at the discharge end of each water bar.

Maintenance and Removal

Inspections should be conducted in accordance with the Storm Water Plan. Inspect water bars for signs of erosion, damage, and sediment buildup. If erosion is identified above or along the water bar, repair the eroded areas and install additional stabilization BMPs to address the cause of erosion. Remove and redistribute sediment in the area of origin or stabilize sediment in place (if removal will have a detrimental effect on reclamation).

Temporary water bars will typically be removed as part of final grading. Once removed, stabilize the impacted area using other erosion and sediment control BMPs.

WATER BAR FIGURES



WATER BAR SPACING		
GRADE (%)	MIN. SPACING (FT)	MAX SPACING (FT)
2	250	415
4	230	380
6	205	350
8	185	320
10	160	285
12	140	250
14	115	220
16	95	185
18	70	150
20	50	120

RECEIVED
MAY 09 2022
MINERALS & MINING PROGRAM

Section VII
Reclamation Plan

Loring Quarry

SIMON

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MAY 09 2022
MINERALS & MINING PROGRAM

RECLAMATION PLAN

Loring Quarry
Sections 33 & 34; T5S-R4E
Custer County, SD

Table of Contents

APPENDICES

1. GENERAL DESCRIPTION

ARSD 74:29:07:18

Simon Contractors of SD, Inc. (Simon) currently owns and operates the Loring Quarry under a mine license. The quarry is located approximately four miles southwest of Pringle, South Dakota in Sections 33 and 34 of Township 5S, Range 4E in Custer County. The quarry is comprised of two parcels both owned by Simon. Parcel 006251 (~45 acres) and parcel 006252 (~126 acres). The quarry is an open pit limestone quarry with reserves estimated to last up to 30 years or more. A total disturbance of approximately 62 acres is anticipated west of the Michelson Trail, with the potential to disturb another 15 acres east of the trail in the long term (40 plus years out). Final reclamation on the majority of the disturbance west of the trail will begin when operations move to the east of the trail. The crusher area will remain while operations are ongoing on the east side of the trail. Final reclamation for the remaining areas will be completed on the west and east sides of the trail when mining operations are fully completed and the crusher and remaining stockpiles of saleable material are removed.

This reclamation plan was prepared and will be implemented in order to meet the reclamation standards as outlined in SDCL 45-6B, ARSD 74:29:02 and ARSD 74:29:05 through ARSD 74:29:08. This plan was prepared by individuals from Simon Contractors of SD, Inc. and H2E, Inc. with experience in developing reclamation plans. Preparer qualifications can be found in Appendix A.

2. PREVIOUSLY MINED LAND

ARSD 74:29:07:17, SDCL 45-6B-8 and SDCL 45-6B-9

The Loring Quarry was purchased from J. Erpelding by Northwest Engineering (Hills Materials) in 1963, and was already a quarry at that time. Simon then acquired Hills Materials in 2015, which included the Loring Quarry. Surface mining disturbance prior to July 1, 1971 was primarily within parcel 006251. Areas mined prior to 1971 have been affected by operations under the mine license and would also be affected by the continued mining operation. This is an open pit limestone quarry and, as such, no underground mining has occurred within the quarry.

3. GRADING

ARSD 74:29:07:03, ARSD 74:29:07:04 and SDCL 45-6B-37

Grading will be done so as to create a final topography appropriate to the final land use of forest; see Reclamation Contours Map in Section VIII of the Large Scale Mine Permit Application (LSMPA) package. Simon will seek input from South Dakota Department of Game, Fish and Parks (SDGFP) regarding leaving highwalls in place for bat habitat prior to blasting and regrading. Highwalls that will not be left in place will be blasted and regraded to a 3:1 slope. Since this consultation for highwall bat habitat with SDGFP cannot be conducted until mining operations are completed in each area, it is not feasible to determine which highwalls will be left in place or blasted and recontoured at this time. In the event that highwalls remain for bat habitat, the amount of available fill material will be reduced. If 3:1 slopes are not feasible in some areas due to a lack of fill material, Simon will ensure that slopes blend with surrounding native and reclaimed lands and that the slopes are stable and no steeper than 2.5:1. By grading slopes to 2.5:1 or flatter, slopes will blend into the surrounding area. This will also result in stable slopes well below the angle of repose.

Backfilling will not occur, apart from what is required to properly recontour the highwalls and return overburden. For areas in which sloping by means of blasting are not possible (i.e. current west-extent highwall that is cut to the property line), overburden stockpiles will be used to backfill

and recontour the highwalls to the appropriate slope, with all overburden removed from each area of the mine (i.e. west side and east side of the mine) being returned to their respective locations. If highwalls are blasted, resulting blasted material will be processed into saleable products. The existing overburden stockpile contains approximately 27,000 cubic yards of material, and an additional 120,000 cubic yards of overburden is anticipated to be stockpiled. Approximately 80,000 cubic yards of overburden material will be used for reshaping of the highwall on the west property line, and all excess overburden not used for recontouring and sloping will be placed at a consistent depth over the limestone floor of the quarry. It is not anticipated that crusher fines will remain as they will likely be sold. Should crusher fines remain at the time of reclamation, they will be incorporated with the overburden as it is placed for recontouring slopes. Backfilling to return the pit area to its original elevation and contour would require approximately 5 million cubic yards of material. It would not be economically feasible to import this amount of material for reclamation purposes. This would also remove all highwalls resulting in the loss of potential bat habitat.

The unnamed intermittent drainage running roughly north to south across the east side of the property as well as the unnamed intermittent drainage running west to east across the southern most corner of the property will be maintained throughout the life of the quarry and final reclamation. A vegetative buffer will be maintained around the drainages to prevent sediment deposition, and the drainages will not be diverted. No depressions for the accumulation of water will remain. It is not anticipated that any unchannelized surface water will need to be diverted around the operation.

All finished and graded slopes will be considerably less than the angle of repose. In most cases the finished slopes will be 2.5:1 or less. Grading will be down to bedrock and the finished slopes will be graded into the mine property protecting land outside the affected area from slides. Final grading will be conducted using construction equipment (e.g. scrapers, blades, dozers, etc.) as appropriate to achieve the desired grade. Slopes will be tracked and seeded upon completion to reduced and eliminate soil erosion. Silt fence, rock dams and other standard best management practices will be installed should erosion issues be identified.

Concurrent reclamation on the west side of the quarry will begin in approximately 2035 and again in approximately 2070; see Section 12 for a detailed discussion. Final reclamation for remaining stockpile and scaling areas will be completed when mining operations are fully completed and the crusher and remaining stockpiles have been removed. The eastern quarry area will begin reclamation near the end-of-life of the mine and final reclamation will follow removal of the highwalls until complete.

4. REFUSE DISPOSAL

ARSD 74:29:07:05, ARSD 74:29:07:13 and SDCL 45-6B-38

Disposal of refuse will not occur at the site during mining or reclamation activities. A privately contracted dumpster will be located on-site at all times and be emptied as needed for proper off-site disposal. Additional smaller receptacles will be available when crushing operations are in progress. Any refuse produced onsite will be removed in a timely manner, so as not to create any unsightliness or unproductive areas, and will not pollute surface or groundwater. Petroleum contaminated soil would be hauled to a proper offsite disposal facility. There should be no refuse to remove once the mine enters the reclamation phase.

There are no circumstances in which any equipment would be abandoned at the quarry. Used mobile equipment parts will be removed from the site by maintenance personnel at the time of replacement. Used crushing equipment parts may be stored on site while the crusher is operating, but would be moved off location when the crusher is moved out. No waste or reject materials are anticipated at this time. If, at some in the future, there is rejected material from the crusher it will be stockpiled for use during reclamation.

The calcium dust shed (~75 ft. x 108 ft.) and scale (6 ft. x 10 ft.) will be removed during reclamation. Any additional buildings or structures that may be constructed or placed within the permit boundary will be removed or deconstructed unless it can be demonstrated that they will be consistent with the approved postmining land use. Building materials from the calcium dust shed, or any other constructed buildings, will be discarded at an appropriate off-site disposal facility.

5. REVEGETATION

ARSD 74:29:02:10, ARSD 74:29:07:06, ARSD 74:29:07:19(1) and SDCL 45-6B-39

Reclaimed areas will be reseeded using native grass species adapted to the location and similar to the surrounding landscape. Seeding will be conducted using either hydro-seeding application or drill seeding as deemed appropriate at time of reclamation. Typically seeding is conducted in the early spring or late fall/winter. Additional amendments (mulching, fertilizer, etc.) may be required as deemed necessary at the time of reclamation. Soil amendments are not anticipated to be needed, but fertilizer may be applied at the time of seeding. The U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) in Rapid City was consulted, and their recommended final seed mix can be found in Appendix B. Correspondence is also provided in Appendix B as proof of consultation. This seed mix is identified as a range planting, which is consistent with the typical understory of a ponderosa pine forest and is physiologically suited for the area. After grasses are established, ponderosa pine seedlings will be planted in areas that were identified as woodland in the pre-disturbance vegetation survey. The area that has previously been disturbed as a result of mining activities will also be planted as if it were a ponderosa pine woodland prior to disturbance. The vegetation survey included percent cover of ponderosa pine rather than density of trees. To calculate ponderosa pine density, an approximate count of individual trees was conducted based on aerial imagery, which resulted in a density of approximately 56 trees per acre within the woodland vegetation community. Ponderosa pine forests are characteristic of the surrounding area and this species is physiologically suited for establishment in the area. The NRCS does not have planting rates for ponderosa pines, and noted that they will typically move into a site from nearby areas without trouble. To speed the reclamation process, the NRCS noted that up to 100 seedlings per acre would be sufficient. A consultation with the Hell Canyon Ranger District Office of the United States Forest Service (USFS) indicated that the USFS plants to a density of 150 seedlings per acre (Appendix B). Therefore, the planting density for ponderosa pine seedlings will be 150 seedlings per acre. Ponderosa pine will be the only woody species planted.

6. TOPSOIL SALVAGE

ARSD 74:29:07:07, SDCL 45-6B-7(11) and SDCL 45-6B-40

All salvageable topsoil and overburden will be removed using scrapers, bulldozer and/or truck/loader methods. Topsoil will be salvaged to a suitable depth according to Table 1 below, across the affected area and overburden salvage depth will vary depending on the depth to mineable limestone. All salvaged topsoil will be stockpiled for reclamation of the location. Stockpiles will remain on location, but be placed outside the active and future planned mining areas. Trees, large rocks or other waste material will be separated from topsoil, if present.

Stockpiles will initially be stabilized using surface roughening to protect from wind and water erosion. The NRCS recommended stockpile seed mix can be found in Appendix B. This mix will be used to stabilize the stockpiles when kept long term (6+ months). Correspondence is provided in Appendix B as proof of consultation. Topsoil stockpiles will be seeded using hydro-seeding or drill seed methods and identified by signs mounted on posts.

Table 1. Suitable Topsoil Salvage Depths and Volume for Proposed Disturbance Area

Map Unit Symbol	Map Unit Name	Soil Series & Associated Disturbed Acreage	Topsoil Salvage Depth (ft)[a]	Total Volume of Topsoil (yd^3)
Q0645C	Rapidcreek cobbly loam, dry, 2 to 10% slopes rarely flooded	Columbo 13.1 ac	5.08	107,364.11
Q0658D	Rockerville-Gurney complex, 2 to 15% slopes	Rockerville 9.6 ac	1.17	18,120.96
Q0665E	Sawdust-Vanocker, dry-Rockerville complex, 10 to 40% slopes	Vanocker 5.0 ac	0.33	2,662.00
Q0659E	Rockerville-Rock outcrop complex, 6 to 30% slopes	1.3 ac	0.00	0.00
Q0702F	Pits, quarry	42.60 ac	0.00	0.00
Total	--	--	--	128,147.07

[a]Based on suitable soil salvage depths provided in the Soil Survey (Appendix D).

On the west side of the Mickelson Trail, topsoil will be stored in the westernmost corner of the property, south of the current topsoil and overburden stockpiles, and to the north of the northernmost area of proposed mining activity. On the east side of the trail topsoil will be stored on the northern end of the property. For topsoil and overburden stockpile locations see Mine Plan Map (LSMPA Section VIII). Overburden will be stored separately from topsoil and stabilized so as to effectively control erosion.

During reclamation, overburden and topsoil will be moved to its final location using scrapers, and/or a truck/loader. A bulldozer will be used for final placement. The redistributed topsoil may be graded, but will always be left in a roughened condition to provide additional protection from wind and water erosion. Simon will always conduct reclamation operations to limit excessive compaction of the redistributed topsoil. Replacement of overburden and topsoil will be one of the final reclamation activities, occurring approximately 2050 or later.

Topsoil replacement depth is estimated to be a minimum of six inches across the affected area. Approximately 49,576 cubic yards of topsoil is estimated to be needed for reclamation west of the trail, and an estimated 11,909 cubic yards of topsoil will be needed for reclamation east of the trail. In total, an estimated 61,485 cubic yards of topsoil will be needed for reclamation and it's anticipated that a total of 128,147 cubic yards will be available; see Table 1. There will be adequate topsoil for reclamation and it is not anticipated that excess topsoil will be used for reclamation purposes elsewhere.

When mining west of the trail is complete and highwalls have been resloped, if not leaving for bat habitat, overburden and topsoil will be replaced. The majority of this reclamation will begin in 2070. Some concurrent reclamation on the west side of the trail will begin in approximately 2035; see Section 12 for a detailed discussion. Due to the nature of the mining activity and the constraints on working space, scale and crushing/stockpile areas will remain on the west side of the trail until all mining activities are completed. Once mining has been completed on the east side of the trail the eastern disturbance and remaining scale/crusher area west of the trail will be reclaimed as described above. It is not anticipated that the reclaimed portion west of the trail will be impacted by reclaiming the working and stockpile area that remains. There will be no temporary distribution of stockpiled topsoil or other suitable material due to the nature of the mining activity.

7. SLIDES, SUBSIDENCE OR DAMAGE PROTECTION, FENCING

ARSD 74:29:07:16 and SDCL 45-6B-42

Areas outside the project boundary, as well as the Mickelson Trail, will be protected from slides, subsidence or damage occurring during mining or reclamation activities via a working and vegetative buffer of no less than 50 ft.

Once mining is complete, highwalls will be reduced to the natural angle of repose or a 3:1 slope, unless it is determined they should remain for bat habitat. Simon shall seek input from SDGFP regarding leaving highwalls for bat habitat.

Access to the quarry is currently limited by a locked gate on the access road, perimeter fencing, and signage. When not active the highwall crest is bermed, and during active mining the highwall crest is marked with yellow reflective markers.

8. SPOILS PILES, WEEDS

ARSD 74:29:07:14(1)(2)(3)(4), ARSD 74:29:07:15 and SDCL 45-6B-43

No tailings will be generated during the mining process. The only spoils produced will be the removed overburden. All mined limestone will be sized into various products and sold, which includes crusher fines. The portable crusher has an onboard water dust suppression system to control airborne particulates. Overburden will be stockpiled in locations outside of existing drainages where any water runoff will be captured on site. Erosive runoff from any other areas will be identified and captured on site. Overburden stockpiles will not be a source of water pollution and is non-toxic. Permanent soil dumps are not required as part of the mining operation. All overburden will be placed prior to the topsoil during reclamation to ensure greater revegetation success and not prevent reestablishment of vegetation on the reclaimed land surface.

Topsoil and overburden stockpiles will be stabilized using applicable best management practices and vegetated for erosion control. Simon will use certified weed-free seed and standard agricultural practices to minimize the introduction of listed or noxious weeds. If weed control is required, a licensed third party contractor shall be contracted for herbicide application following all applicable regulations and best practices. Weed control will be required during all phases of the mining operation and initial reclamation. Herbicides to be used, application rates and application times will depend on the weed species and location. Recommendations from the Custer County Conservation District regarding weed control can be found in Appendix C. Custer County Weed and Pest Department was consulted by phone and provided the South Dakota State University (SDSU) Extension 2020 Weed Control document (Appendix C). This document lists

noxious weeds along with recommended herbicides, application rates and any restrictions. Field bindweed, a local noxious weed, was identified during the vegetation survey and control of this species will begin this coming growing season. Subsequent herbicide treatments will be conducted as needed. Per SDSU Extension recommendations, herbicides, such as picloram, should be applied when the plant begins flowering or to regrowth that has emerged in the fall. Several other herbicides are listed for control of field bindweed and herbicide specific application rates can be found in the SDSU Extension document.

9. LANDOWNER CONSULTATION

ARSD 74:29:06:01, ARSD 74:29:06:02, SDCL 45-6B-12 and SDCL 45-6B-44,

Simon is the surface landowner as well as owner of the mineral interest; therefore the instrument of consultation is not applicable. The USFS and SDDOT are the only adjacent landowners. The USFS was consulted in developing a revegetation strategy for ponderosa pine seedlings. Adjacent landowners will receive a copy of the Reclamation Plan once it has been deemed complete by the Department.

After conferring with the Department of Agriculture and Natural Resources the post-mine land use will be forest. The post-mine land use of forest is compatible with the surrounding land use. The quarry is surrounded by USDA Black Hills National Forest. Support and maintenance activities are discussed throughout this plan and include storm water inspections, noxious weed control and vegetation monitoring. Returning the quarry to forest is obtainable, of beneficial use, and Simon has the financial capability to complete this reclamation. No commitments from public agencies are required, but as discussed in Section 3 the SDGFP will be consulted regarding leaving highwalls for bat habitat prior to blasting and regrading. This may require the commitment of personnel time from the department. Reclamation is planned pursuant to the mine sequence schedule. There are no known land use plans/programs that include the quarry area.

10. RECLAMATION CHOICES, OPERATOR REQUIREMENTS

ARSD 74:29:06:02 through ARSD 74:29:06:05, ARSD 74:29:07:01, ARSD 74:29:07:18 through ARSD 74:29:07:26, SDCL 45-6B-7(1) and SDCL 45-6B-45

Simon will restore a stable, non-erosive post-mining surface which promotes a post-mining land use of forest. The estimated area to be reclaimed is approximately 62 acres west of the trail and 15 acres east of the trail. This post-mine land use is typical of the surrounding area. Reforestation and revegetation practices will establish cover sufficient to prevent undue erosion as well as establish species diversity and composition which supports the intended land use.

Reclamation success will be determined by comparing post-mine vegetation to results from the baseline vegetation survey. Methods for collecting vegetation data will follow the baseline survey found in Appendix D. Reclamation will be considered successful when the reclaimed areas reach 70% of the pre-disturbance ponderosa pine stand density within five years of planting seedlings. Pre-disturbance stand density is not included in the baseline vegetation survey, but was estimated based on aerial imagery and is included in the revegetation section of this plan. Other criteria for determining reclamation success will include establishing desirable perennial vegetation, as compared to the undisturbed woodland and upland grassland locations in the baseline survey, and verifying that understory vegetation is diverse, self-sustaining and adequate to control erosion. Steep slopes flattening out to valley floors is characteristic of the surrounding area. The final graded slopes, excluding any highwalls that may remain for bat habitat, are not expected to exceed the slopes in the surrounding area.

In order to successfully implement and reclaim the disturbed area, storm water inspections will continue until final bond release as outlined in the SWPPP provided with the Operating Plan. Inspections will not only allow for the monitoring of storm water issues, but will allow for ongoing monitoring of vegetation establishment as well as presence of invasive species.

Vegetation similar to the natural pre-mining vegetation will be seeded using hydro-seeding and/or drill seed application methods. Simon will ensure that slopes blend with surrounding native and reclaimed lands and that the slopes are stable. Once grasses are established, final reclamation will include forest planting of ponderosa pine seedlings to support forest land use. Planting methods and care of stock will follow good planting practices. Reclamation is anticipated to be completed 4-5 years after cessation of mining operations.

It is anticipated that some highwalls may remain as part of the reclaimed area for bat habitat. Evaluation of habitat would be coordinated with the SDGFP. If a highwall is determined not to be suitable bat habitat, it will be reduced to a 3:1 slope or less and be reclaimed.

Simon has no intended plan for future industrial, homesite or mineral exploration after the life of the quarry. Simon has the financial capability to perform the required reclamation, which is planned pursuant to the mine sequence schedule. Simon understands that the conditions and requirements of the reclamation plan must be met prior to final bond release.

11. RECLAMATION TIME TABLE

SDCL 45-6B-46

Simon will complete the reclamation described above with all reasonable diligence and estimates reclamation will be completed approximately 4-5 years after cessation of mining. There will be no unsuitable land, roads, permanent pools or lakes or other features in which revegetation will not be feasible.

12. CONCURRENT AND INTERIM RECLAMATION

ARSD 74:29:08

Concurrent reclamation efforts for the disturbance west of the Mickelson Trail will begin in approximately 2035 when stripping begins to the west of the current quarry pit (area '2036-2042' on the Mine Sequence Map). Stripped topsoil will be stockpiled for later use and overburden will be moved directly to final placement for highwall sloping along the southwest property line. The next opportunity for concurrent reclamation will be in approximately 2070 when highwall lay-back begins at the northern extent of the disturbance area. Limestone will be mined to final grade and processed, and final topsoil placement and seeding will occur the following year. SDGFP will be consulted regarding highwalls during concurrent reclamation as described in Section 3.

Due to the nature of the construction activity and the constraints on working space, scale and stockpile areas will remain on the west side until all mining activities are completed. Final reclamation for the remaining stockpile and scaling areas will be completed on the west side of the trail when mining operations are fully completed and the crusher and remaining stockpiles and removed. Should mining operations change in the future and areas are identified that can be reclaimed earlier concurrent to mining operations, reclamation will be initiated in accordance with this plan.

Concurrent reclamation to the east of the trail will proceed in a similar manner as to the west of the trail. The eastern quarry area will begin reclamation near the end-of-life of the mine and final reclamation will follow removal of the highwalls until complete.

13. POSTCLOSURE PLAN

SDCL 45-6B-5(5) and SDCL 45-6B-91

After the reclamation bond is released, post closure monitoring will consist of annual visits to the location to identify any erosion issues, noxious weeds or required fencing maintenance. There will be no treatment of tailings or monitoring systems at this location. Should any erosion, fugitive dust, weeds or other maintenance be required it will be carried out with all reasonable diligence. Vegetation will be qualitatively monitored during the annual inspections to ensure establishment of a self-sustaining vegetative community.

14. RECLAMATION OF MILL SITES

ARSD 74:29:05

No mill sites will be constructed in conjunction with this mining operation.

15. MAPS

ARSD 74:29:02:12 and SDCL 45-6B-7(8)

Post reclamation maps showing the anticipated physical appearance and final contours of the reclaimed mine as well as an outline of the proposed final land areas can be found in Section VIII of the LSMPA package.

16. BONDING

ARSD 74:29:02:08, SDCL 45-6B-20 and SDCL 45-6B-20.1

Estimated reclamation cost is approximately $5,511 per acre. Total disturbance west of the trail is estimated to be approximately 62 acres, with an additional 15 acres east of the trail. This cost includes the placement of overburden and topsoil, finishing topsoil for seeding and cost to seed, fertilize and mulch. This also includes the cost to plant ponderosa pine seedlings once grasses have established. Phased bonding will not be requested, please see Table 3 below for a detailed reclamation cost estimate.

Table 3. Loring Quarry Reclamation Cost Estimate

Work Description	Reclaim Acres	Quantity CY/Acre	Cost per CY	Cost Per Acre	Cost for 77 Acres
Place Overburden at 0 inches[a]	-	807	$2.50	$2,018	-
Place Topsoil at 6 inches[a]	77	807	$2.50	$2,018	$155,348
Finish Topsoil for Seeding [b]	77			$510	$39,270
Seed, Fertilize and Mulch[c]	77			$1,100	$84,700
Demo Scale & Building[d]					$20,000
Drill, Shoot and Slope Highwalls[e]					$125,000
Total Cost to Reclaim					$424,318
Cost to Reclaim per Acre					$5,511

[a]Scraper cost.
[b]D8 and operator at $170 per hour at 3 hours per acre.
[c]Subcontractor cost.
[d]Dust shed is ~108 ft x 75 ft; scale is ~10 ft x 6 ft.
[e]Ancillary Lump Sum.

Appendix A

Qualifications

Extraordinary Environmental Consulting Services

Becky Morris

Senior Environmental Scientist

Dr. Morris is a seasoned environmental scientist with over 12 years of experience in the environmental regulatory compliance industry and 6 years of experience in the field of veterinary toxicology. She has an extensive knowledge of the effects contaminants can have in both terrestrial and aquatic environments, as well as the potential for impacts on aquatic, domestic and wildlife species. Her toxicology background provides a unique asset in the environmental regulatory compliance industry. Past roles in this area have ranged from field technician to project manager to Wyoming Pollutant Discharge Elimination System (WYPDES) monitoring supervisor. Currently she is a Spill Prevention Contingency and Countermeasures (SPCC), project manager for several clients. She also develops reclamation and storm water plans for facilities throughout the region.

Experience

- Managed the WYPDES monitoring department for an environmental consulting firm, which included oversight of 4 to 10 field technicians.
- Coordinated with clients and other consulting firms to implement Agricultural Use Protection Policy (AUPP) requirements in the field.
- Managed SWPPP programs for upstream and midstream oil and gas clients including SWPPP preparation and active/inactive inspections.
- Managed 800+ facility SPCC annual inspection/update project for oil and gas tank batteries, midstream facilities and electrical transformers.
- Served as a client project manager for all WYPDES project related needs (i.e. permitting, monitoring and reporting).
- Permitted coal bed natural gas and traditional oil/gas outfalls under WYPDES.
- Managed the Whole Effluent Toxicity Test (WETT) program for various clients.
- Developed reclamation plans and oversaw vegetation data gathering and processing for site clearance.
- Evaluated water quality and identified contaminants of concern in the Yellowstone and Missouri Rivers, in Montana, to aid in pallid sturgeon recovery.
- Conducted contaminant assessment processes on National Wildlife Refuges, which incorporates fate and flow of pathogens and contaminants in both terrestrial and aquatic habitats.
- Conducted toxicological investigations examining the accumulations of metals, from environmental exposure, in Greater sage grouse and various Wyoming fish species.
- Proficient with sample collection (tissue, blood, water, soil) and preparation for toxicological analyses.
- Knowledgeable regarding toxicological diagnostic analyses including ICP-MS, UPLC-MS and GC-MS.
- Active training/certifications include: PEC Premier - Safe Land Training, H2S Awareness and CPR/First Aid.
- Proficient with Microsoft Office Suite as well as AutoCad.

Education

University of Wyoming, Laramie, WY
Bachelor of Science - Biology, 2002

Doctorate of Philosophy, Animal and Veterinary Sciences (Focus: Toxicology), 2008

Extraordinary Environmental Consulting Services

Clay Wood

Reclamation Specialist

Clay Wood is an oil and gas environmental professional specializing in reclamation and invasive species management. He ensures environmental and regulatory compliance from the planning stages through final reclamation by ensuring regulatory standards are met and that reclamation is progressing toward successful final reclamation. He has experience working directly with multiple state agencies, BLM, and EPA. Mr. Wood has 10 years of experience working in the energy industry working for invasive species control companies and for oil and gas environmental compliance consulting companies.

Experience

- Coordinated reclamation contractors, solicited bids, and provided oversight of reclamation activities throughout the Rocky Mountain Region.
- Conduct pre-disturbance vegetation assessments throughout the Rocky Mountain Region.
- Conduct interim and final reclamation vegetation assessments throughout the Rocky Mountain Region.
- Conducted threatened and endangered plant species and species of concern habitat assessments and population inventories throughout Wyoming and Colorado.
- Developed weed management plans for projects throughout the Rocky Mountain Region.
- Developed site specific reclamation plans for oil and gas projects throughout the Rocky Mountain Region.
- Mixed and applied herbicides for noxious and invasive species control in Wyoming.
- Soil sampling to determine topsoil salvage depth throughout the Rocky Mountain Region.
- Soil sampling at contaminated/release sites, direction of excavation, lab analysis, and reporting.
- Wetland delineation throughout the Rocky Mountain Region and Texas.
- Stormwater inspections for energy projects throughout the Rocky Mountain Region.
- Use of GIS equipment to accurately collect spatial field data.
- Provide environmental health and safety education for employees and contractors to ensure ensure compliance with regulatory and client standards.
- Experience conducting NEPA analysis.

Education

University of Wyoming - MS, Plant Sciences - Rangeland Invasive Species
University of Wyoming - BS, Rangeland Ecology and Watershed Management, Reclamation and Restoration Ecology Minor

Certified Professional in Rangeland Management
Certified Ecological Restoration Practitioner
Commercially Licensed Pesticide Applicator

Nathan Oliver: North Region Quarries Manager

SDSM&T, B.S. Mining Engineering 2010

—Kiewitt Mining, Decker Coal Co.

- Assisted with post-reclamation vegetation survey, 2009

—Goldcorp, Wharf Resources

- Assisted with backfill design and long-range planning for American Eagle Pit reclamation, 2009-2010
- Assisted with North Foley Pit denitrification pad upgrade/expansion design, 2009

—Hills Materials Company

- Managed and directed final reclamation at various small gravel pits in the southern Black Hills, 2012

—Simon Contractors

- Responsible for management oversight of all Reclamation Projects at SIMON NORTH Region -4 limestone quarries and 4 Sand/Gravel locations

  Some Projects at SIMON include:
  - 2020 management oversight for reclamation of ~20 acres at Maverick Pit outside of Hot Springs, SD per the agreement and environmental requirements
  - 2020 management oversight for ~45 acres of reclamation at the TA Ranch Pit outside of Buffalo, WY in accordance with WY DEQ standard
  - 2021 management oversight for reclamation of ~5 acres at Rapid City Quarry approved by SDNR
  - 2022 currently managing and conducting reclamation at three sites within the region for a total of ~40 acres

Jake Hepp: North Region Aggregates Manager

SDSM&T, B.S. Mining Engineering 2016

—Peabody Energy

- Oversaw reclamation with relation to Post Mine topography at Caballo Mine outside of Gillette, WY, 2010

—LafargeHolcim

- Assisted with reclamation projects in the Great Lakes Region, 2016-2017
  - 6 sand/gravel pits and 1 limestone quarry with total production of ~3 mil/tons per year

—Melgaard Construction

- Oversaw all Reclamation at all pits/quarries, 2017-2019
  -8 different locations consisting of limestone, sand/gravel, and scoria
  -All locations in the state of Wyoming and were in accordance with WY DEQ standards

—Simon Contractors

- Responsible for overall direction of Aggregate Division at SIMON, 2019-2022
  -Direct yearly Reclamation Projects at SIMON NORTH Region
  -4 limestone quarries and 4 Sand/Gravel locations

  Some Projects at SIMON include:
  - 2020 reclamation of ~20 acres at Maverick Pit outside of Hot Springs, SD per the agreement and environmental requirements
  - 2020 ~45 acres of reclamation at the TA Ranch Pit outside of Buffalo, WY in accordance with WY DEQ standard. The final reclamation is an irrigated productive grass and alfalfa field for crop production
  - 2021 reclamation of ~5 acres at Rapid City Quarry approved by SDNR
  - 2022 currently managing and conducting reclamation at three sites within the region totally ~40 acres

Appendix B

NRCS Seeding Plan & Correspondence

Instructions

SEEDING PLAN

Producer	Loring Quarry	Conservation District:	Custer	MLRA	62
Program	CTA	Practice No.	342	Practice Name:	Critical Area Seeding
CI or Referral No.		Contract #			

Resource Concern (CPPE Impact)	Purpose:
Final Mix	342- Stabilize areas with existing or expected high rates of soil erosion by wind or water

PLANNED		
Tract		Seedbed Preparation
Field	NA	Clean, smooth, weed free seedbed will be prepared
Acres	1.00	
Group or Site	Critical Area Group	
Site (Web Soil Survey)	Loamy or Silty Texture	
Date to be Planted (TechNote4)	Early Spring Prior to 5/15	
Alternative planting dates		Protection Provided
Alternative planting dates		Clip weeds before they compete for moisture and light
Seeding Equipment	Special Grass Drill	
Companion Crop	None	

PLANNED

Species * **	1/ Select Improved Variety (recommended) or select common seed (see note below)	Percent in Mixture 107	Pure Live Seeds (PLS) per square foot 43.20	Pure Live Seed (PLS) lbs/ac Needed	Acres to Seed	Pure Live Seed (PLS) lbs Required
Big bluestem		20.0	9.00	2.23	1.00	2.23
Green needlegrass		3.0	1.35	0.33	1.00	0.33
Little bluestem		3.0	1.35	0.21	1.00	0.21
Prairie dropseed		3.0	1.13	0.22	1.00	0.22
Slender wheatgrass		15.0	5.63	1.58	1.00	1.58
Virginia wildrye		3.0	1.35	0.61	1.00	0.61
Western wheatgrass		45.0	16.88	6.56	1.00	6.56
American vetch		1.0	0.38	0.54	1.00	0.54
Purple prairie clover		1.0	0.38	0.06	1.00	0.06
White prairie clover		1.0	0.38	0.06	1.00	0.06
Leadplant		1.0	0.45	0.10	1.00	0.10
Western snowberry		1.0	0.45	0.26	1.00	0.26
Sideoats grama		10.0	4.50	1.09	1.00	1.09

Annual Ryegrass may be added in addition to this full seeding- but must be seeded at a rate at or below 2 PLS lbs/ac.

To meet SD NRCS Standards Please Note:

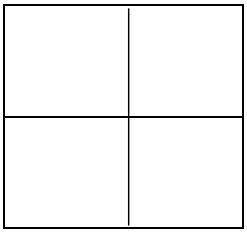
1/ Improved varieties recommended above have no restrictions on their origin.
1/ Origin of Common grass seed must be ND, SD, NE, MT, WY, MN, or IA. Exception: Smooth Bromegrass any locale.
1/ Common Native forbs and legumes will originate or be grown in (USA): ND, SD, NE, MT, IA, WY, ID, WA, OR, MN, WI, and (CAN): AB, BC, MB, ON, SK.

- Seed test must be completed according to SD Seed laws (see link below) and no more than 9 months prior to the date planted.
- All legumes must be pre-inoculated . Producer will provide all seed tags to NRCS Legume inoculants
- Tetrazolium (TZ) tests may be used as a substitute for germination tests ONLY for Green Needlegrass
- For Alfalfa Salinity tolerence use F or G from the web site link ---> Alfalfa Variety Ratings

* Pubescent wheatgrass and Intermediate wheatgrass are the same species and can be substituted for one another at any time.
** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available but only west of the Missouri River. To calculate the amount needed multiply the western wheatgrass seeding rate by .72

SD Seed Laws: Codified Laws Statute 38-12A
Seed testing: SD state seed-lab

LOCATION MAP



Tract
S.
T.
R.

Planning Assistance By: Mitch Faulkner (Name) 4/1/2022 (Date)

Plan Meets SD Standards (if no explain) Yes ☐ No ☐

SEEDING APPLIED

Cooperator **Loring Quarry** Conservation District **Custer** MLRA **62**

Program **CTA** Practice No. 342 Practice Name: Critical Area Seeding

CI or Referral No. _____ Contract # _____ Planning By: Mitch Faulkner

Resource Concern (CPPE Impact)	Purpose:
	342- Stabilize areas with existing or expected high rates of soil erosion by wind or water

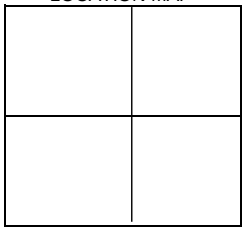
APPLIED

Tract		Seedbed Preparation
Field	NA	
Acres Planted		
Group or Site	Critical Area Group	
Critical Area Group	Loamy or Silty Texture	
Date Planted		
		Protection Provided
Seeding Equipment		
Companion Crop		

APPLIED

Seed Species	% of full rate planned	% of full rate Applied	Variety or Seed Source	1/ Origin	Test Date 2/ MM/YYYY	Percent Purity	Percent Germ. 3/	Pounds Bulk Seed Planted	Acres Certified	PLS Pounds Planted
Percent in Mixture										

LOCATION MAP



Tract _____

S. _____

T. _____

R. _____

Seeded By: _____

Certified By: _____
Name

Certified Date: _____

Applied Practice Meets SD Standards and Specifications

(if no explain below) Yes ☐ No ☐

Comments on Performance:

Complete the applied tab (species, acres, % germ, %purity, lbs bulk from seed tags and bills) that will be applied to the tract/field. Then fill in the Blue Cells on Table A and B on this sheet.

Table A. Species List from Applied *(for single or mixed species plantings)*			**Acres->**		**Drill Box ->**	
Tract / Field --->		***Data below is from the applied and applied2 sheets***			**Total Bulk Lbs. of seed Per Acre**	**Total Bulk Lbs. of seed needed for the entire acreage**
Species	**Variety**	**% of Full Rate Applied**	**Seeding Rate in *PLS Lbs. per acre***	**Seeds per Lb.**	**% Purity**	**% Germ.**
Totals---->			**Total Bulk Seed per Acre--->**			

Table B. Seed Calculator for All Drills & Planters		
Use this section to determine the grams of seed to collect from the seed tube(s) or opener(s)	**Distance between seed openers *(in inches)***	
	Circumference of Drive Wheel *(in inches)*	
	PLS Lbs. of Seed per Acre	
	Bulk Lbs. of Seed per Acre	
	Number of Drive Wheel Revolutions	
	Enter the number of seed tubes collected	
	Total Grams bulk Seed Required from the Seed Tube(s)	
This section indicates the number of seeds dropped based on inputs above	**Seeds per Lb. *(Bulk seed)***	
	Seeds dropped *per opener* per drive wheel revolution	
	Seeds per square foot. *(Bulk seed)*	
	Seeds per foot of row *(Bulk seed)*	

04/01/22

NRCS Cost Estimate For Planning

This cost estimate is based on an average costs of seed dealers **and doesn't necessarily reflect the actual cost shared amounts that will be in a conservation contract**. Seed costs can vary from dealer to dealer and prices can and have fluctuated drastically in response to supply and demand during the year. Please contact seed dealers to receive a timely quote for the kind and amount of seed you plan to plant.

Up to 4 Seed dealers were used to determine the average cost of species.
June 1, 2020 the costs were last updated.

Seeding Mixture		|--------- PER ACRE ----------|		|---------- 1 Total Acres ----------|	
Critical Area Group		Planned	Estimated	Total	Total
- Loamy or Silty Texture	%	LBS PLS	Cost	PLS LBS	Estimated Cost
Big bluestem	20.0	2.23	$25.48	2.23	$25.48
Green needlegrass	3.0	0.33	$2.84	0.33	$2.84
Little bluestem	3.0	0.21	$2.72	0.21	$2.72
Prairie dropseed	3.0	0.22	$38.43	0.22	$38.43
Slender wheatgrass	15.0	1.58	$6.85	1.58	$6.85
Virginia wildrye	3.0	0.61	$4.80	0.61	$4.80
Western wheatgrass	45.0	6.56	$32.82	6.56	$32.82
American vetch	1.0	0.54	$68.06	0.54	$68.06
Purple prairie clover	1.0	0.06	$2.57	0.06	$2.57
White prairie clover	1.0	0.06	$4.27	0.06	$4.27
Leadplant	1.0	0.10	$7.92	0.10	$7.92
Western snowberry	1.0	0.26	Unknown	0.26	Unknown
Sideoats grama	10.0	1.09	$9.19	1.09	$9.19

Totals	107.0	|--------- PER ACRE ----------|	|---------- 1 Total Acres ----------|
Estimated Cost --------->		**$205.95** *Plus Unknown costs*	**$205.95** *Plus Unknown costs*
Pure Live Seed Pounds --------->		13.85 PLS LBS	13.85 PLS LBS

PLS = Pure, Live Seed **LBS**. = Pounds
* Pubescent wheatgrass may be substituted for intermediate wheatgrass at any time.
** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available and only west of the Missouri River.
To obtain a seeding rate for thickspike wheatgrass multiply the western wheatgrass seeding rate by .72

Additional costs for establishing or reestablishing cover typically can include:

Seedbed preparation: As low as $10.00 per acre for a burn down on a clean field of soybean stubble to as high as $80.00 per acre for treatment of perennial vegetation with chemical and tillage. Fields with perennial vegetation and/or noxious weeds will cost more to prepare a clean, weed free seedbed and cropping for a couple years prior to seeding should be considered.

Seeding: Drills capable of planting fluffy grass seed which have good depth control can cost up to 30.00 per acre to rent. Additional costs can be incurred if a tractor and drill operator are hired.

Weed Control: Weeds will need to be controlled before they compete for moisture and light. Weed control is critical to the establishment of the seedlings. Clipping may need to be preformed up to 3 times during establishment. Herbicides may in some cases be an alternative to clipping. You must follow label guidelines and all state laws regarding herbicide application. Clipping costs typically can range from $8.00 to $25.00 per acre. Herbicide costs can typically range from $10.00 to $40.00 per acre for weed control.

Seeding Plan

Vendor Information Sheet

04/01/22

Producer & Phone #	Loring Quarry		Conservation District:	Custer
NRCS Office & Phone #	Belle Fourche Service Center	605-892-3368	Planned Planting Date:	Early Spring Prior to 5/15
Planner	Mitch Faulkner			

Note to Producer:

Purchasing a seed mix that meets conservation practice standards and conservation program requirements (if applicable) is the responsibility of the client. When considering the purchase of a seeding mix that is different from the attached seeding plan, it is the client's responsibility to make sure the seeding mix is approved by an NRCS conservation planner prior to purchase. Failure to seed an NRCS approved seed mix may result in denial of financial or cost share assistance.

Note to Vendor:

If any substitutions to species or varieties are considered please obtain prior approval by calling the Producer and NRCS at the numbers above. If 1/ Improved Varieties recommended are not available they may be substituted with a different SD approved variety (see back of sheet) or with "common seed" (See Common Seed definition and origin requirements below). Please provide a seed tag to the producer for each bag purchased. As always follow state seed law concerning labeling. Thank You!

Seeding Mixture

Major Land Resource Area 62
Critical Area Group Loamy or Silty Texture

Common Name	Scientific Name	1/ Improved Variety	% of Mix	PLS Pounds per Acre	Acres	PLS Pounds **Total**
Big bluestem	Andropogon gerardii		20.0	2.23	1.00	2.23
Green needlegrass	Nassella viridula		3.0	0.33	1.00	0.33
Little bluestem	Schizachyrium scoparium		3.0	0.21	1.00	0.21
Prairie dropseed	Sporobolus heterolepis		3.0	0.22	1.00	0.22
Slender wheatgrass	Elymus trachycaulus		15.0	1.58	1.00	1.58
Virginia wildrye	Elymus virginicus		3.0	0.61	1.00	0.61
Western wheatgrass	Pascopyrum smithii		45.0	6.56	1.00	6.56
American vetch	Vicia americana		1.0	0.54	1.00	0.54
Purple prairie clover	Dalea purpurea		1.0	0.06	1.00	0.06
White prairie clover	Dalea candida		1.0	0.06	1.00	0.06
Leadplant	Amorpha canescens		1.0	0.10	1.00	0.10
Western snowberry	Symphoricarpos occidentalis		1.0	0.26	1.00	0.26
Sideoats grama	Bouteloua curtipendula		10.0	1.09	1.00	1.09
Total			*107.0*	*13.85*	*1.00*	***13.85***

To meet SD NRCS Standards Please Note:

1/ Improved varieties recommended above have no restrictions on their origin.

1/ Origin of Common grass seed must be ND, SD, NE, MT, WY, MN, or IA. Exception: Smooth Bromegrass any locale.

1/ Common Native forbs and legumes will originate or be grown in (USA): ND, SD, NE, MT, IA, WY, ID, WA, OR, MN, WI, and (CAN): AB, BC, MB, ON, SK.

- Seed test must be completed according to SD Seed laws (see link below) and no more than 9 months prior to the date planted.
- All legumes must be pre-inoculated . Producer will provide all seed tags to NRCS — Legume inoculants
- Tetrazolium (TZ) tests may be used as a substitute for germination tests ONLY for Green Needlegrass
- For Alfalfa Salinity tolerence use F or G from the web site link ---> Alfalfa Variety Ratings

* Pubescent wheatgrass and Intermediate wheatgrass are the same species and can be substituted for one another at any time.

** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available but only west of the Missouri River.

SD Seed Laws — Codified Laws Statute 38-12A

Seed testing — SD State Seed-lab

The seeding plan was developed from recommendations based on the NRCS Soil Survey and South Dakota Field Office Technical Guide.

Critical Area Group **Loamy or Silty Texture**

This seeding is planned in Major Land Resource Area (MLRA) **62**

Varieties/Cultivars that are approved for South Dakota Include:

Common Name			
Big bluestem			
Bison	Bonanza	Bonilla	Bounty
Central Iowa Germplasm	Champ	Common	Northern Iowa Germplasm
Pawnee	Rountree	Sunnyview	
Green needlegrass			
AC Mallard Ecovar	Common	Lodorm	
Little bluestem			
Badlands Ecotype	Blaze	Camper	Central Iowa Germplasm
Common	Itasca	Northern Iowa Germplasm	Southern Iowa Germplasm
Prairie dropseed			
Common			
Slender wheatgrass			
AC Pintail Ecovar (Bearded)	AC Sprig Ecovar (Bearded)	Adanac	AEC Hillcrest
Common	Elbee	FirstStrike	Primar
Pryor	Revenue		
Virginia wildrye			
Common	Omaha	Tober Germplasm	
Western wheatgrass			
Arriba	Barton	Common	Flintlock
Recovery	Rodan	Rosana	Walsh
American vetch			
Common			
Purple prairie clover			
Bismarck	Common	Kaneb	
White prairie clover			
Antelope	Common		
Leadplant			
Common			
Western snowberry			
Common			
Sideoats grama			
Butte	Central Iowa Germplasm	Common	Killdeer
Northern Iowa Germplasm	Pierre	Southern Iowa Germplasm	Trailway

Instructions

SEEDING PLAN

Producer	Loring Quarry	Conservation District:	Custer	MLRA	62
Program	CTA	Practice No.	342	Practice Name:	Critical Area Seeding
CI or Referral No.		Contract #			

Resource Concern (CPPE Impact)	Purpose:
Top Soiling Seed Mix Example	342- Stabilize areas with existing or expected high rates of soil erosion by wind or water

PLANNED		
Tract		Seedbed Preparation
Field		Clean, smooth, weed free seedbed will be prepared
Acres	1.00	
Group or Site	Critical Area Group	
Site (Web Soil Survey)	Loamy or Silty Texture	
Date to be Planted (TechNote4)	Early Spring Prior to 5/15	
Alternative planting dates		Protection Provided
Alternative planting dates		Clip weeds before they compete for moisture and light
Seeding Equipment	Special Grass Drill	
Companion Crop	None	

PLANNED

Species * **	1/ Select Improved Variety (recommended) or select common seed (see note below)	Percent in Mixture 103	Pure Live Seeds (PLS) per square foot 40.20	Pure Live Seed (PLS) lbs/ac Needed	Acres to Seed	Pure Live Seed (PLS) lbs Required
Western wheatgrass		55.0	20.63	8.02	1.00	8.02
Green needlegrass		3.0	1.35	0.33	1.00	0.33
Slender wheatgrass		15.0	5.63	1.58	1.00	1.58
Canada wildrye		5.0	1.50	0.57	1.00	0.57
Sideoats grama		10.0	4.50	1.09	1.00	1.09
Big bluestem		10.0	4.50	1.11	1.00	1.11
Lewis flax		1.0	0.38	0.06	1.00	0.06
Purple prairie clover		1.0	0.38	0.06	1.00	0.06
Little bluestem		3.0	1.35	0.21	1.00	0.21
Annual Ryegrass may be added in addition to this full seeding- 1.0 - 1.5 lbs per acre, and must be seeded at a rate at or below 2 PLS lbs/ac.						

To meet SD NRCS Standards Please Note:

1/ Improved varieties recommended above have no restrictions on their origin.

1/ Origin of Common grass seed must be ND, SD, NE, MT, WY, MN, or IA. Exception: Smooth Bromegrass any locale.

1/ Common Native forbs and legumes will originate or be grown in (USA): ND, SD, NE, MT, IA, WY, ID, WA, OR, MN, WI, and (CAN): AB, BC, MB, ON, SK.

- Seed test must be completed according to SD Seed laws (see link below) and no more than 9 months prior to the date planted.
- All legumes must be pre-inoculated . Producer will provide all seed tags to NRCS Legume inoculants
- Tetrazolium (TZ) tests may be used as a substitute for germination tests ONLY for Green Needlegrass
- For Alfalfa Salinity tolerence use F or G from the web site link ---> Alfalfa Variety Ratings

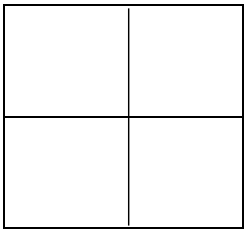
* Pubescent wheatgrass and Intermediate wheatgrass are the same species and can be substituted for one another at any time.

** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available but only west of the Missouri River. To calculate the amount needed multiply the western wheatgrass seeding rate by .72

SD Seed Laws: Codified Laws Statute 38-12A

Seed testing: SD state seed-lab

LOCATION MAP



Tract

S.

T.

R.

Planning Assistance By: Mitch Faulkner (Name) 4/1/2022 (Date)

Plan Meets SD Standards (if no explain) Yes ☐ No ☐

SEEDING APPLIED

Cooperator **Loring Quarry** Conservation District **Custer** MLRA **62**

Program **CTA** Practice No. 342 Practice Name: Critical Area Seeding

CI or Referral No. _____ Contract # _____ Planning By: Mitch Faulkner

Resource Concern (CPPE Impact)	Purpose:
	342- Stabilize areas with existing or expected high rates of soil erosion by wind or water

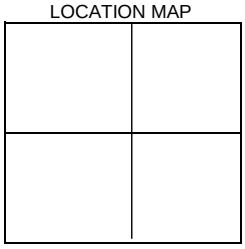
APPLIED

Tract		Seedbed Preparation
Field		
Acres Planted		
Group or Site	Critical Area Group	
Critical Area Group	Loamy or Silty Texture	
Date Planted		
		Protection Provided
Seeding Equipment		
Companion Crop		

APPLIED

Seed Species	% of full rate planned	% of full rate Applied	Variety or Seed Source	1/ Origin	Test Date 2/ MM/YYYY	Percent Purity	Percent Germ. 3/	Pounds Bulk Seed Planted	Acres Certified	PLS Pounds Planted
Percent in Mixture										

LOCATION MAP



Tract _____

S. _____

T. _____

R. _____

Seeded By: _____

Certified By: _____
Name

Certified Date: _____

Applied Practice Meets SD Standards and Specifications

(if no explain below) Yes ☐ No ☐

Comments on Performance:

Complete the applied tab (species, acres, % germ, %purity, lbs bulk from seed tags and bills) that will be applied to the tract/field. Then fill in the Blue Cells on Table A and B on this sheet.

Table A. Species List from Applied *(for single or mixed species plantings)*			**Acres->**		**Drill Box ->**	
Tract / Field --->		***Data below is from the applied and applied2 sheets***			**Total Bulk Lbs. of seed Per Acre**	**Total Bulk Lbs. of seed needed for the entire acreage**
Species	**Variety**	**% of Full Rate Applied**	**Seeding Rate in *PLS Lbs. per acre***	**Seeds per Lb.**	**% Purity**	**% Germ.**
Totals---->			**Total Bulk Seed per Acre--->**			

Table B. Seed Calculator for All Drills & Planters		
Use this section to determine the grams of seed to collect from the seed tube(s) or opener(s)	**Distance between seed openers *(in inches)***	
	Circumference of Drive Wheel *(in inches)*	
	PLS Lbs. of Seed per Acre	
	Bulk Lbs. of Seed per Acre	
	Number of Drive Wheel Revolutions	
	Enter the number of seed tubes collected	
	Total Grams bulk Seed Required from the Seed Tube(s)	
This section indicates the number of seeds dropped based on inputs above	**Seeds per Lb. *(Bulk seed)***	
	Seeds dropped *per opener* per drive wheel revolution	
	Seeds per square foot. *(Bulk seed)*	
	Seeds per foot of row *(Bulk seed)*	

04/01/22

NRCS Cost Estimate For Planning

This cost estimate is based on an average costs of seed dealers **and doesn't necessarily reflect the actual cost shared amounts that will be in a conservation contract**. Seed costs can vary from dealer to dealer and prices can and have fluctuated drastically in response to supply and demand during the year. Please contact seed dealers to receive a timely quote for the kind and amount of seed you plan to plant.

Up to 4 Seed dealers were used to determine the average cost of species.
June 1, 2020 the costs were last updated.

Seeding Mixture		|--------- PER ACRE ----------|		|---------- 1 Total Acres ----------|	
Critical Area Group		Planned	Estimated	Total	Total
- Loamy or Silty Texture	%	LBS PLS	Cost	PLS LBS	Estimated Cost
Western wheatgrass	55.0	8.02	$40.11	8.02	$40.11
Green needlegrass	3.0	0.33	$2.84	0.33	$2.84
Slender wheatgrass	15.0	1.58	$6.85	1.58	$6.85
Canada wildrye	5.0	0.57	$3.94	0.57	$3.94
Sideoats grama	10.0	1.09	$9.19	1.09	$9.19
Big bluestem	10.0	1.11	$12.74	1.11	$12.74
Lewis flax	1.0	0.06	$2.64	0.06	$2.64
Purple prairie clover	1.0	0.06	$2.57	0.06	$2.57
Little bluestem	3.0	0.21	$2.72	0.21	$2.72

Totals	103.0	|--------- PER ACRE ----------|	|---------- 1 Total Acres ----------|
Estimated Cost --------->		**$83.60**	**$83.60**
Pure Live Seed Pounds --------->		13.02 PLS LBS	13.02 PLS LBS

PLS = Pure, Live Seed **LBS**. = Pounds
* Pubescent wheatgrass may be substituted for intermediate wheatgrass at any time.
** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available and only west of the Missouri River.
To obtain a seeding rate for thickspike wheatgrass multiply the western wheatgrass seeding rate by .72

Additional costs for establishing or reestablishing cover typically can include:

Seedbed preparation: As low as $10.00 per acre for a burn down on a clean field of soybean stubble to as high as $80.00 per acre for treatment of perennial vegetation with chemical and tillage. Fields with perennial vegetation and/or noxious weeds will cost more to prepare a clean, weed free seedbed and cropping for a couple years prior to seeding should be considered.

Seeding: Drills capable of planting fluffy grass seed which have good depth control can cost up to 30.00 per acre to rent. Additional costs can be incurred if a tractor and drill operator are hired.

Weed Control: Weeds will need to be controlled before they compete for moisture and light. Weed control is critical to the establishment of the seedlings. Clipping may need to be preformed up to 3 times during establishment. Herbicides may in some cases be an alternative to clipping. You must follow label guidelines and all state laws regarding herbicide application. Clipping costs typically can range from $8.00 to $25.00 per acre. Herbicide costs can typically range from $10.00 to $40.00 per acre for weed control.

Seeding Plan

Vendor Information Sheet

04/01/22

Producer & Phone #	Loring Quarry		Conservation District:	Custer
NRCS Office & Phone #	Belle Fourche Service Center	605-892-3368	Planned Planting Date:	Early Spring Prior to 5/15
Planner	Mitch Faulkner			

Note to Producer:

Purchasing a seed mix that meets conservation practice standards and conservation program requirements (if applicable) is the responsibility of the client. When considering the purchase of a seeding mix that is different from the attached seeding plan, it is the client's responsibility to make sure the seeding mix is approved by an NRCS conservation planner prior to purchase. Failure to seed an NRCS approved seed mix may result in denial of financial or cost share assistance.

Note to Vendor:

If any substitutions to species or varieties are considered please obtain prior approval by calling the Producer and NRCS at the numbers above. If 1/ Improved Varieties recommended are not available they may be substituted with a different SD approved variety (see back of sheet) or with "common seed" (See Common Seed definition and origin requirements below). Please provide a seed tag to the producer for each bag purchased. As always follow state seed law concerning labeling. Thank You!

Seeding Mixture

Major Land Resource Area 62
Critical Area Group Loamy or Silty Texture

Common Name	Scientific Name	1/ Improved Variety	% of Mix	PLS Pounds per Acre	Acres	PLS Pounds **Total**
Western wheatgrass	Pascopyrum smithii		55.0	8.02	1.00	8.02
Green needlegrass	Nassella viridula		3.0	0.33	1.00	0.33
Slender wheatgrass	Elymus trachycaulus		15.0	1.58	1.00	1.58
Canada wildrye	Elymus canadensis		5.0	0.57	1.00	0.57
Sideoats grama	Bouteloua curtipendula		10.0	1.09	1.00	1.09
Big bluestem	Andropogon gerardii		10.0	1.11	1.00	1.11
Lewis flax	Linum lewisii		1.0	0.06	1.00	0.06
Purple prairie clover	Dalea purpurea		1.0	0.06	1.00	0.06
Little bluestem	Schizachyrium scoparium		3.0	0.21	1.00	0.21
Total			*103.0*	*13.02*	*1.00*	***13.02***

To meet SD NRCS Standards Please Note:

1/ Improved varieties recommended above have no restrictions on their origin.

1/ Origin of Common grass seed must be ND, SD, NE, MT, WY, MN, or IA. Exception: Smooth Bromegrass any locale.

1/ Common Native forbs and legumes will originate or be grown in (USA): ND, SD, NE, MT, IA, WY, ID, WA, OR, MN, WI, and (CAN): AB, BC, MB, ON, SK.

- Seed test must be completed according to SD Seed laws (see link below) and no more than 9 months prior to the date planted.
- All legumes must be pre-inoculated . Producer will provide all seed tags to NRCS — Legume inoculants
- Tetrazolium (TZ) tests may be used as a substitute for germination tests ONLY for Green Needlegrass
- For Alfalfa Salinity tolerence use F or G from the web site link ---> Alfalfa Variety Ratings

* Pubescent wheatgrass and Intermediate wheatgrass are the same species and can be substituted for one another at any time.

** Thickspike wheatgrass may be substituted for western wheatgrass if the later is not available but only west of the Missouri River.

SD Seed Laws — Codified Laws Statute 38-12A

Seed testing — SD State Seed-lab

The seeding plan was developed from recommendations based on the NRCS Soil Survey and South Dakota Field Office Technical Guide.

Critical Area Group **Loamy or Silty Texture**

This seeding is planned in Major Land Resource Area (MLRA) **62**

Varieties/Cultivars that are approved for South Dakota Include:

Common Name

Western wheatgrass

Arriba	Barton	Common	Flintlock
Recovery	Rodan	Rosana	Walsh

Green needlegrass

AC Mallard Ecovar	Common	Lodorm

Slender wheatgrass

AC Pintail Ecovar (Bearded)	AC Sprig Ecovar (Bearded)	Adanac	AEC Hillcrest
Common	Elbee	FirstStrike	Primar
Pryor	Revenue		

Canada wildrye

Common	Mandan

Sideoats grama

Butte	Central Iowa Germplasm	Common	Killdeer
Northern Iowa Germplasm	Pierre	Southern Iowa Germplasm	Trailway

Big bluestem

Bison	Bonanza	Bonilla	Bounty
Central Iowa Germplasm	Champ	Common	Northern Iowa Germplasm
Pawnee	Rountree	Sunnyview	

Lewis flax

Appar	Common

Purple prairie clover

Bismarck	Common	Kaneb

Little bluestem

Badlands Ecotype	Blaze	Camper	Central Iowa Germplasm
Common	Itasca	Northern Iowa Germplasm	Southern Iowa Germplasm

From:	Faulkner, Mitch - NRCS, Belle Fourche, SD
To:	Becky Morris
Subject:	RE: Updated Seeding recommendation for Loring Quarry
Date:	Tuesday, April 5, 2022 3:01:06 PM
Attachments:	image001.png Seeding ToolLoringQuarry_Topsoil.pdf

HI Becky- That is definitely longer than I had in my mind, but makes sense. Check this topsoil seeding out and see what you think- It is a little over 100% to accommodate at least 15% slender. I added small amounts of other species to better cover functional structural groups for the long term and soil health considerations, yet kept with 75% rhizomatous grasses. The seeding rate is our critical area seeding assuming it is drilled. If broadcast it will be 1.5x. We don't have a standard (seedrate) for stockpile but assume it is relatively smooth and somewhat level. First page and last page are most important in this PDF file. Who knows what plant materials will be available in 2070?
Thanks
Mitch

Mitch Faulkner
Area Rangeland Management Specialist
USDA-NRCS
Belle Fourche, SD
Cell: (605) 519-1446

From: Becky Morris <BMorris@h2eincorporated.com>
Sent: Monday, April 4, 2022 9:30 AM
To: Faulkner, Mitch - NRCS, Belle Fourche, SD <mitch.faulkner@usda.gov>
Subject: RE: Updated Seeding recommendation for Loring Quarry

Hi Mitch-

Thanks for getting back to me so quickly - it's much appreciated!

Final reclamation won't begin until sometime around 2070, so the stockpiles will be around for a while. I think the simpler seed mix for the stockpiles is the way to go. Is 20 lbs per acre still sufficient for the stockpile seed mix? You are correct in that the topsoil will be laid back on top of the overburden and reseeded with the permanent mixture during final reclamation. We haven't seen hard fescue used for that purpose either. Seems like it would be a good species for that, but don't have any firsthand experience with it as a soil stabilizer.

Thanks again-
Becky

Becky Morris
H2E, Inc.
307-696-7007

From: Faulkner, Mitch - NRCS, Belle Fourche, SD <mitch.faulkner@usda.gov>
Sent: Friday, April 1, 2022 3:17 PM
To: Becky Morris <BMorris@h2eincorporated.com>
Subject: Updated Seeding recommendation for Loring Quarry

Hi Becky- I have attached an updated seeding plan that will likely help you out. The first and last page are the important ones. Let me know if you have questions or want to visit about this as I currently design these seedings with the NRCS Critical Area Planting practice, and Justine planned it with the 550 range planting practice so that makes some differences in design and seeding rates. It probably comes down to preference or individual judgement when doing these.
Some things to notice in this one:
I made the assumption that it is loamy textured soils and would be drilled- I also made sure we had about 75% rhizomatous grasses in the full seeding and went a little over 100% to accommodate a little extra slender wheatgrass (which SD NRCS considers a bunchgrass). We usually put slender in at a significant quantity because it establishes fast. I tried to stick with your original plan of species as well as I could.

Just one question on the top soil mixture- how long will those soils be topsoiled? I assume that the topsoil will be laid back on top of the overburden and reseeded with a permanent mixture. I think we can get away with a much simpler seeding than the SDDOT Type E seeding to meet your goals and our standards if this is the case. Would something like the below work?
Western Wheatgrass 55%
Slender wheatgrass 20%
Canada wildrye 5%
Sideoats grama 10%
Big bluestem 10%
Annual Rye at an additional 1.5 PLS lb/ac

It has been my practice to try to stay away from non-native perennial plants even on soil stabilizing projects. I have been told hard fescue works well but I don't have any experience with it. Have you ever seen it used? It is in SD NRCS guidelines, but I don't know if it can encroach on other sites or be invasive. It is a bunch grass so it makes me a little more open to considering it more often especially in areas with some timber.

Thanks!

Mitch Faulkner
Area Rangeland Management Specialist
USDA-NRCS
Belle Fourche, SD
Cell: (605) 519-1446

Warning - This Email Originated from a Sender Outside H2E. If you do not recognize the sender or are suspicious of the emails content, contact internal support. **Do Not** open attachments, click on links or reply to the sender.

Appendix C

Custer County Conservation District & SDSU Extension Weed Control

CUSTER COUNTY CONSERVATION DISTRICT
25363 US Hwy 385
Custer, SD 57730
Phone: 605-673-5680

September 9, 2021

Simon Contractors of South Dakota, Inc.
3975 Sturgis Rd
Rapid City, SD 57702

Simon Contractors of South Dakota, Inc.:

This letter is to acknowledge receipt of your letter dated 8-30-2021, regarding your mining permit for the Loring Quarry property. We have several general comments that may already be addressed in your reclamation plan. Our comments are as follows:

1) Treat noxious weeds ensuring that these treatments are kept concurrent with mining operations. Ore removal, transport, and processing can be a vector for weed spread, if not controlled at the source. When reseeding, a seed mix native to the area, should help reduce weed establishment and spread. The Natural Resources Conservation Service (NRCS) offices in Rapid City and Hot Springs can provide specific seed recommendations.

2) Ensure that any surface run-off from the mining area or access road is minimized and adequately treated before leaving the mining area.

3) Provide for safety of the facility so that people or livestock are not endangered by operations or land/mine slopes or drop-offs.

4) Follow any reclamation standards that have been established and approved, as well as requirements for posting reclamation bonds. During reclamation, reshape to the natural character of the land.

Thank you for considering these comments. We appreciate your diligence in caring for soil and water resources while providing important mineral resources.

Sincerely,

Mike Baldwin
CCCD Office Manager

CC: SD DANR
SD Dept. of Agriculture & Natural Resources
Minerals and Mining Program
523 East Capitol Ave.
Pierre, SD 57501

SDSU Extension

2020 Weed Control

FEBRUARY 2020

SOUTH DAKOTA STATE UNIVERSITY®
AGRONOMY, HORTICULTURE AND PLANT SCIENCE DEPARTMENT

ABBREVIATIONS.
Several abbreviations are used in this publication

ae = acid equivalent
ai = active ingredient
DF = dry flowable
DG = dispersible granule
DS = dry soluble
gal = gallon
gpa = gallons per acre
L = liquid
lb = pound
NIS = non-ionic surfactant
oz = ounce
psi = lb per square inch
pt = pint
qt = quart
T = Tablespoon
t = teaspoon
WDG = water soluble powder

Noxious Weeds

Paul O. Johnson | SDSU Extension Weed Science Coordinator
David Vos | SDSU Ag Research Manager **Jill Alms** | SDSU Ag Research Manager
Leon Wrage | SDSU Distinguished Professor Emeritus

WATCH for NOXIOUS WEED INVADERS

Noxious weeds are non-native plant species that are a concern to South Dakota land owners and managers. They can replace native plant species and impede agriculture, recreation, and wildlife.

2018 Noxious Weed Infestations[1]

State noxious	Acres
Canada thistle	1,515,919
Leafy spurge	362,477
Perennial sow thistle	116,699
Hoary cress	26,756
Russian knapweed	5,813
Purple loosestrife	9,159
Saltcedar	3,497
Local noxious	
Biennial thistle (bull, musk and plumeless)	238,387
Absinth wormwood	228,057
[1]Estimates from 2018 State Noxious Weed Annual Report, SD Dept. of Agriculture	

LOCAL NOXIOUS WEEDS

Some of the weeds listed below may be designated as locally noxious in your county. Requirements for controlling local noxious weeds are similar for controlling state noxious weeds.

- Absinth wormwood
- Black henbane
- Bull thistle
- Chicory
- Common burdock
- Common mullein
- Common tansy
- Dalmatian toadflax
- Diffuse knapweed
- Eurasian common reed
- Flowering rush
- Field bindweed
- Giant knotweed
- Houndstongue
- Musk thistle
- Oxeye daisy
- Plumeless thistle
- Poison hemlock
- Puncturevine
- Scotch thistle
- Spotted knapweed
- St. Johnswort
- Sulfur cinquefoil
- White horehound
- Yellow toadflax

HERBICIDES for NOXIOUS WEEDS

Noxious Weed Recommendations: Herbicides for pasture, range, and non-crop areas, including roadside and other right-of-way that may be harvested for hay or grazed, are given a priority.

Non-Crop Areas: Non-cropland is defined for herbicide purposes as areas not used to produce food or feed crops during the time herbicide residue remains in the soil. Non-crop areas include parking lots, utility storage areas and some rights-of-way. Pasture, range and hay land are cropland.

Herbicides: Herbicides are listed by trade name except where the active ingredient is available in several products. The common name (in parentheses) follows the first listing of the trade name. Product labels for the same active ingredient vary. Herbicides included are those considered for most situations and those generally available. The order in which herbicides are listed does not reflect control results. Right-of-ways are frequently grazed or used for hay, therefore grazing and haying restrictions should be considered when selecting herbicides.

CONTENTS

Absinth Wormwood (Wormwood sage) Management: Absinth wormwood is a perennial species that also is a prolific seed producer, so plants may re-establish a few years after control. Just 2,4-D can be effective, but two applications (spring and fall) may be required for control. Herbicides such as Milestone, ForeFront, or Tordon may be effective with one application. Herbicides may be effective in the spring up to the end of June, but may be ineffective after early June during abnormally dry springs. In trees, apply 2,4-D after tree leaves turn color and sage is still green.

Biennial Thistles (Musk, Plumeless, Bull and Scotch) Management: These species generally emerge as rosettes in the fall and early spring and bolt during the second year of growth. Control is most consistent when herbicides are applied at the rosette stage. Tordon or Milestone may provide some short-term residual control for plants that germinate after the herbicide application. At the rosette stage, 2,4-D may be very effective. After bolting occurs, consider using aminopyralid (Milestone or GrazonNext HL) or metsulfuron (Escort or Cimarron). The musk thistle seed weevil (Rhinocyllus conicus) and the rosette weevil (Trichosirocalus horridus) have been released in many areas of South Dakota and can be found in most musk thistle infestations.

Black Henbane Management: Black henbane is an annual or biennial weed that can invade disturbed areas in pastures, roadsides, or forested areas. Henbane can be toxic to humans and livestock but livestock will generally avoid eating it if other forage is available. It is most common in the Black Hills area, but can also be found in central South Dakota.

Burdock Management: Common burdock is a biennial weed that is most often a problem in shelterbelts. Consequently, it can be challenging to use herbicides to control burdock without injuring the trees. Furthermore, burdock often develops a persistent seed bank so plants may appear again within a couple years after control. 2,4-D is commonly used for burdock control, but care must be taken to avoid injury to trees or nearby gardens or crops.

Canada Thistle Management: Canada thistle and perennial sowthistle develop extensive root systems which can make them difficult to control. Seeds can spread by wind, making it important to control the plants prior to seed production. Canada thistle seeds may become viable within 10 days after flowering. Standard programs include Tordon + 2,4-D, 2,4-D (for maintenance programs), Milestone, or ForeFront. Stinger or Transline may be used for Canada thistle around some tree species, but follow label precautions. These herbicides may be applied from mid-June (pre-bud stage) to Sept. or early Oct. (fall regrowth while the leaves are mostly green). It is preferred to control Canada thistle before seed production in early July. Dense grass may reduce control from fall applications, so consider setting-up the site with mowing or grazing in the summer prior to fall applications. Biocontrol insects can be fairly effective on Canada thistle in some infestations, but overall success rates are low. Stem mining weevils may be most effective.

Chicory Management: Chicory is a perennial species that may be invasive in pastures and along roadsides in any area throughout South Dakota.

Common Mullein Management: Common mullein is a biennial species that grows rosettes the first year and bolt during the second year of growth. Apply herbicides at the rosette stage during periods of active growth. For common mullein, use a recommended surfactant to help the herbicide penetrate the extremely hairy leaf surface.

Common Tansy Management: Common tansy is a perennial species that seems to be particularly invasive in or near wooded areas, such as the Black Hills. Common tansy may often be found in low areas or near waterways. It mainly spreads by seeds, but will also spread by creeping roots. Metsulfuron products (e.g. Escort) are commonly used for control.

Eurasian Common Reed (Phragmites) Management: European common reed (Phragmites australis subsp. Australis) is a perennial grass species that looks similar to the native common reed (Phragmites australis subsp. Americanus), which is not a local noxious weed species. The fluffy plume on European common reed may be denser than the native common reed. European common reed stems may be rigid, rough, dull, and slightly ribbed whereas native common reed stems are smooth and shiny. Both reed species may be found in sunny wetland habitats including marshes, streams or lake shores, ponds, wet meadows, and road ditches or in areas where cattails may be found. Aquatic glyphosate has been very effective in some locations.

Field Bindweed Management: Field bindweed is a perennial species that develops an extensive root system making it difficult to control. Management programs may require several years. Apply herbicides at the beginning of flowering or to regrowth in the fall.

Flowering Rush Management: Flowering rush can spread aggressively in shallow-water areas, inhibiting access, crowding out native vegetation, and changing aquatic habitat for fish and other organisms. Vehicles or wildlife can spread seed and root fragments.

Giant Knotweed Management: As the name suggests, giant knotweed is a large plant that can get 6 to 16 ft tall with heart-shaped leaves 6-16 inches long. It has a unique bamboo-like hollow stem. It often grows near streams, so herbicide options may be limited. Aquatic glyphosate is the only herbicide registered for knotweed control. Studies in other states have indicated that foliar applications of imazapyr (e.g. Habitat) or triclopyr (e.g. Vastlan) may also be effective, Giant knotweed is generally very difficult to control with herbicides.

Hoary Cress Management: Hoary cress is a perennial species that can develop an extensive root system. Hoary cress may be challenging to control because it flowers in early spring (late April-early May), which is the best time for herbicide applications. SDSU trials indicate metsulfuron products (e.g. Escort) are the most effective. Growth regulator herbicides such as Tordon or 2,4-D are ineffective. Hoary cress may be found in low areas, such as gullies, ditches, dry lakebeds, or near lakes or streams.

Houndstongue Management: Houndstongue is a biennial species that grows rosettes the first year and bolt during the second year of growth. Apply herbicides at the rosette stage during periods of active growth.

Knapweed Species (Russian, Spotted, and Diffuse) Management: Russian knapweed is a persistent perennial species that can develop an extensive root system making it difficult to control. Spotted and diffuse knapweed are biennial or short-lived perennial species and are generally easier to control. Herbicides may be applied to Russian knapweed at the bud-flowering growth stage or in late fall (early to mid-October) after the plants appear dormant. Apply herbicides to spotted or diffuse knapweed in the spring or fall while they are in the rosette to early-bolting growth stage. Several biocontrol agents have been released for the knapweed species. The knapweed flower or seed weevil (Larinus minutus) has been successful, especially on spotted knapweed.

Leafy Spurge Management: Leafy spurge is a perennial species that develops extensive root systems making it very difficult to control. Management programs typically require several years and can be very costly. Therefore, it is strongly recommended to watch for new patches and control infestations while they are small. Standard herbicide programs include Tordon, Tordon + 2,4-D, or Plateau. Apply herbicides in the spring (early June) at flowering or to regrowth in the fall (September-October or while the white sap is still flowing). Plateau may be used around trees, but follow label precautions. For large infestations, consider introducing biocontrol agents such as leafy spurge flea beetles (Aphthona lacertosa or Aphthona nigriscutis). Contact your local county weed and pest board or the South Dakota Department of Agriculture for more information on flea beetle collection dates and procedures.

Oxeye Daisy Management: Oxeye daisy may be found throughout South Dakota, but it is most problematic in the Black Hills area. It mostly infests open meadows and other grassy areas. Grazing can increase oxeye daisy densities, but intensive grazing can result in some control due to trampling plants and some feeding. Thick grass can greatly suppress oxeye daisy.

Perennial sowthistle Management: (see Canada thistle)

Poison Hemlock Management: Poison hemlock is a biennial species that grows only foliage the first year and bolts and flowers the second year. Poison hemlock may be confused with wild carrot, but poison hemlock often grows taller, has purple blotches on its stems, and will have no hairs whereas wild carrot may be slightly hairy. Poison hemlock is toxic to livestock and humans. It may be found along roadsides, stream banks, waste areas, pasture edges, and occasionally in no-till fields. Control may require a multiple year effort. Escort may be the most effective herbicide option.

Puncturevine Management: Puncturevine is an annual weed species, but is problematic because it produces large spiny burs that can puncture vehicle tires. It may be found on roadsides or field roads where the soil is dry and compacted. It is very susceptible to 2,4-D, but new seedlings may emerge after application which can make this weed difficult to control.

Purple Loosestrife Management: Purple loosestrife is often found growing on the edge of lakes or streams, so be sure to use herbicide products that are registered for use on or near water. The best time to apply herbicides is at the beginning of flowering (late June to early July). Alternative control options may include repeated tillage, burning, or biocontrol insects. The Galerucella leaf feeding beetles have been effective biocontrol insects for purple loosestrife. Beetles reared in South Dakota are available through the South Dakota Department of Agriculture.

Saltcedar (Tamarix species) Management: Saltcedar is a very persistent tree species as it can reproduce by seed, roots, or stem fragments. It is a prolific seed producer and can spread rapidly. It produces pink, red, or purple flowers in mid-summer and the cedar-like leaves will turn yellow in the fall and fall off in the winter. It can be found along the water line on the edges of streams, lakes, ponds, or dugouts. Habitat may be applied to the foliage whereas triclopyr products, such as Vastlan, may be applied to the trunk or stems in winter.

St. Johnswort Management: St. Johnswort spreads by seed and creeping roots. Repeated tillage may suppress populations and repeated mowing may help reduce seed spread. Biocontrol insects have been effective for large infestations in western states.

Sulfur Cinquefoil Management: Sulfur cinquefoil is a perennial weed that can become invasive in grasslands, particularly in western South Dakota, For cinquefoil, follow-up applications may be needed 2-3 years after initial applications.

Toadflax (Dalmatian and Yellow) Management: Dalmatian and yellow toadflax spread by seeds and creeping roots. Dalmatian toadflax is generally more sensitive to herbicides than yellow toadflax. Yellow toadflax control requires high herbicide rates and several years of application which can become very costly. Therefore, it is strongly recommended to watch for new infestations and control populations while they are small. For yellow toadflax, SDSU trials indicate that Tordon at 1-2 qt/A may be the most effective herbicide option. Applications of 2,4-D at flowering may defoliate yellow toadflax and help reduce spread by seed, but will only provide approximately 20% control the following year. Biocontrol insects have been effective on large Dalmatian toadflax infestations, but are not effective on yellow toadflax.

White Horehound Management: White horehound was introduced as an ornamental. It is hardy and spreads by seed. It likes open and disturbed areas of range, pasture and lawns.

Herbicides:

Sensitive areas:

Charts and tables:

Trade names for herbicides are used in this publication to aid reader recognition. The common name is also listed and is used for herbicides that are available in many labeled products. Examples of other product names are listed where possible based on information available. As patents expire and marketing agreements are formed, additional products may be marketed. Be sure crop use and application directions are followed for the product being used.

NOXIOUS WEEDS LISTED ON HERBICIDE LABELS

C=Control

PC=Partial control

S=Suppression

-- = Not labeled

	HERBICIDES																		
NOXIOUS WEEDS	**2,4-D**	**Dicamba + 2,4-D**	**Dicamba**	**Overdrive**	**Milestone**	**GrazonNext/Forefront**	**Opensight/Chaparral**	**Capstone**	**Tordon + 2,4-D**	**Tordon**	**Plateau**	**Stinger/Transline**	**Curtail**	**Remedy Ultra**	**Vastlan**	**Cimarron Max**	**Cimarron Plus**	**Telar**	**Escort**	**Method**
Absinth wormwood	C	--	C	--	C	C	C	C	C	C	--	--	--	--	--	--	--	--	--	--
Black henbane	--	--	C	--	C	--	C	--	--	C	--	--	--	--	--	C	C	--	C	--
Burdock, common	C	C	C	C	C	C	C	C	--	--	--	C	C	C	C	C	--	--	--	--
Canada thistle	PC	S	C	C	C	C	C	C	C	C	--	C	C	--	C	S	S	C	S	C
Chicory	C	C	C	--	C	C	C	C	C	--	--	--	--	C	S	C	C	--	C	C
Eurasian common reed	--	--	--	--	--	--	--	--	--	--	--	--	--	--	C	--	--	--	--	--
Field bindweed	PC	C	C	C	--	--	--	C	C	C	C	--	--	--	C	S	S	--	S	C
Giant knotweed	--	--	--	--	S	--	--	S	--	--	--	--	--	--	--	--	--	--	--	--
Hoary cress (whitetop)	PC	--	--	--	--	--	C	--	--	--	C	--	--	--	--	C	C	C	C	--
Houndstongue	--	--	--	--	--	--	C	--	C	--	C	--	--	--	--	C	C	C	C	--
Knapweed, diffuse	--	--	C	C	C	C	C	C	--	C	--	C	C	--	--	--	--	--	--	C
Knapweed, Russian	--	S	C	--	C	C	C	C	--	C	C	S	S	--	--	S	--	C	S	C
Knapweed, spotted	--	C	C	C	C	C	C	C	--	C	--	C	C	--	--	C	C	--	--	C
Leafy Spurge	--	S	C	--	--	--	--	--	C	C	C	--	--	--	--	S	--	--	--	C
Mullein, common	--	--	--	--	C	C	C	C	C	C	--	--	--	--	--	C	C	C	C	C
Oxeye daisy	--	--	--	C	C	C	C	C	C	C	--	C	--	--	--	C	--	--	C	C
Perennial sowthistle	C	S	C	C	C	C	C	C	--	C	--	S	S	--	--	S	--	--	--	C
Poison hemlock	--	--	--	--	--	--	S	--	C	--	C	--	--	--	--	C	C	C	C	C
Puncturevine	--	--	C	C	--	--	--	--	--	--	C	--	--	--	--	--	--	C	--	--
Purple loosestrife	--	--	--	--	C	--	C	C	--	--	--	--	--	--	C	C	C	--	C	--
Saltcedar	--	--	--	--	--	--	--	--	--	--	--	--	--	C	C	--	--	--	--	--
St. Johnswort	--	--	--	--	C	--	C	C	--	C	--	--	--	--	--	C	C	--	C	--
Sulfur cinquefoil	--	--	--	--	C	C	C	C	--	C	--	--	--	C	--	C	C	--	C	C
Tansy, common	--	--	--	--	--	--	C	--	--	--	--	--	--	--	--	C	C	C	C	--
Thistle, bull	C	C	C	C	C	C	C	C	C	C	C	C	C	C	--	C	C	C	C	--
Thistle, musk	PC	C	C	C	C	C	C	C	C	C	C	C	C	--	--	C	C	C	C	C
Thistle, plumeless	--	C	C	C	C	C	C	C	C	C	--	--	--	--	--	C	C	--	C	--
Thistle, Scotch	--	--	C	--	C	C	C	C	C	C	--	--	--	--	--	C	C	C	C	--
Toadflax, Dalmatian	--	--	--	--	--	--	--	--	C	C	C	--	--	--	--	--	--	C	S	C
Toadflax, yellow	--	--	--	--	--	--	--	--	--	C	--	--	--	--	--	--	--	C	S	--
White horehound	--	--	--	--	--	S	--	--	--	--	--	--	--	--	--	--	--	--	--	--

TORDON 22K *(picloram)* RESTRICTED USE PESTICIDE.

0.5 pt-2 qt Tordon 2L (0.125-1 lb ae) ($3.10-35.75)

Picloram is available in several brand name products, including **Picloram 22K**, **Triumph** and **Trooper**. Formulation and use may vary. Follow directions for product used. Tordon has foliar activity and extended soil residual. It controls top growth and translocates into roots. Rainfall is required to move the herbicide into the root zone. Trees, legumes, and broadleaf plants are very sensitive to drift and soil residues.

Tordon is registered for use in grass pasture and range, CRP, fallow cropland and non-crop areas. At high rates, Bromegrass, buffalograss, and wheatgrass may be injured; bluegrass is tolerant. Minimum carrier is 10 gpa for ground and 2 gpa for air; however, for non-crop 15 gpa or more is recommended for ground and 5-20 gpa for air. For spot treatment use a minimum of 20 gpa.

Restrictions: Do not use near trees as root uptake will result in severe tree injury or death. Avoid drift to trees or sensitive broadleaf crops. For rates above 1 qt/A, do not harvest for hay within 2 weeks after treatment. Do not graze dairy animals for 2 weeks after treatment. Remove animals 3 days before slaughter if grazing within 2 weeks after spraying. Residues will remain in animal urine, so do not spread manure from cattle feeding on treated forage or grazing on broadleaf crops. Residue may remain on treated grass harvested for hay, so do not feed in areas where broadleaf crops may be planted. Do not apply into water or wetlands or on inner banks of irrigation or drainage ditches. Risk of leaching is greatest where soils have rapid permeability (such as loamy to sand) and where the underlying aquifer is near the surface. Broadcast rates above 1 qt/a are only allowed for noxious and invasive weeds; however, spot treatments up to 2 qt/A may be applied to other broadleaf weeds but cannot exceed 50% of an acre.

ABSINTH WORMWOOD: 1-2 pt
Spring or Fall. Use Tordon alone or as a tank-mix with 2,4-D ester. Apply in spring before wormwood is over 12 inches. Tordon at 1 pt alone or Tordon plus 2,4-D has provided excellent results in SDSU tests. Results on larger plants have been better than for 2,4-D. Promising as a fall treatment.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH): 0.5-0.75 pt
Fall or Spring: Apply at the seedling or rosette stage. Use Tordon at 0.5-0.75 pt for fall; use Tordon plus 2,4-D for spring application. Provides excellent control under a wide range of growing conditions. Visual effects develop more slowly than for some treatments.

BLACK HENBANE: 1-2 pt
Spring. Apply to actively growing plants in the rosette growth stage.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 1.5-2 pt (Canada thistle); 4 pt (perennial sowthistle)
Spring or Fall. Primarily for small infestations. Use a minimum of 20 gpa carrier. The 1 qt/A rate has been promising in Canada thistle tests. Stands have been reduced 85 to 90% in SDSU tests. Make spring treatments before seed forms. Make fall applications while foliage is still green. Use the high rate for maximum stand reduction, especially for fall treating areas such as fence lines. Control one year later is greater than for lower Tordon rates in tank-mixes.

COMMON MULLEIN: 1-1.5 pt
Spring. Apply at rosette stage prior to stalk elongation. Use Tordon at 1-1.5 pt in a tank-mix with 2,4-D at 1 lb ae. Treatments have exceeded 90% control in tests in western South Dakota. Use surfactant to improve penetration through woolly leaf surface. Use at least 30 gallons water per acre to ensure thorough coverage. Reduction is apparent for at least 2 years.

COMMON TANSY: 2-3 pt
Spring, early summer. Apply before bloom. Tordon is not registered for common tansy control however; results in SDSU tests show 75 to 90% control. The 2 pt/A rate is minimal; adding 1 lb ae/A 2,4-D ester is suggested with the low rate.

FIELD BINDWEED: 1-2 qt
Spring or Fall. Primarily for small patches. Rates above 1 pt/A can be used in fallow cropland if the treated areas are less than 10% of the field. The 2 qt rate will reduce the stand; however, additional Tordon or other follow-up is required. Some regrowth may be noted after application during dry seasons. Make spring treatments before seeds form. Make fall application before soil freeze-up.

KNAPWEED SPECIES: 1-2 pt diffuse or spotted; 2-4 pt Russian
Spring or Fall. For diffuse or spotted knapweed, apply 1-2 pt/A in the spring to plants in the rosette or mid-bolting growth stage or in the fall to regrowth. Control at the 1 pt/A rate may be improved by tank mixing with 1 qt/A 2,4-D. For Russian knapweed, apply 2-4 pt/A to actively growing plants in the bud to mid-flowering growth stage or in the fall to regrowth. Some studies have demonstrated very good Russian knapweed control after late-fall applications.

LEAFY SPURGE: 1-2 qt
Spring or Fall. Spring applications generally slightly more effective. Primarily for small patches. The 2 qt rate will reduce the stand; however, additional Tordon or other follow-up is required. Some regrowth may be noted after application during dry seasons. Make spring treatments at true flower before seeds form. Make fall application to regrowth before soil freeze-up.

OXEYE DAISY: 1.5-2 pt
Spring. Apply while plants are actively growing. It is recommended to use at least 30 gallons water per acre to ensure thorough coverage. May mix lower rate with 2,4-D at 1 lb ae/A.

ST. JOHNSWORT: 2-4 pt
Spring or Fall. Use Tordon alone or as a tank-mix with 2,4-D. Has provided excellent control in SDSU tests. Spring application at bud stage gave 95% control for a 2-year period. Reduce the Tordon rate to 0.5 pt/A when used with 2,4-D if conditions are favorable. Control has averaged 90 to 95% for one year.

SULFUR CINQUEFOIL: 1 pt
Spring or Fall. Apply to actively growing plants in the spring or to regrowth in the fall.

TOADFLAX (DALMATIAN AND YELLOW): 1-2 qt
Late summer (flowering) or Fall. For Dalmatian toadflax, apply 1-2 qt to actively growing plants through the full bloom stage or in late summer or fall. Use Tordon in tank-mix with 2,4-D in spring before full bloom. For yellow toadflax, Tordon at 2 qt/A may provide 60-70% control the following year. May require annual treatment for 2 to 3 years.

TORDON 22K + 2,4-D ESTER *(picloram + 2,4-D)* RESTRICTED USE PESTICIDE.

0.5 pt-1 qt Tordon 2L + 1-1.5 lb ae 2,4-D ester (0.125-0.5 + 1-1.5 lb ae) ($6.55-20.90)
1-3 qt Gunslinger P+D, Picloram+D or Trooper P+D 2.54L (0.135-0.405 + 0.5-1.5 lb ae)
1.25 pt - 2 qt Graslan L 3.81L (0.13-0.405 + 0.47-1.5 lb ae)

The tank-mix is registered for non-crop, grass pasture, and range. Use Graslan L for CRP, range, pasture, and non-crop. Grass is usually tolerant to these Tordon rates. Some stunting, especially if applied at boot stage, may be noted. Minimum carrier is 10 gpa for ground or 2 gpa for air.

Restrictions: See individual restrictions for Tordon and 2,4-D.

ABSINTH WORMWOOD (WORMWOOD SAGE):
0.5-1 pt Tordon + 1 lb ae 2,4-D ester, 2- 4 pt (2.54L), or 1.25-2.66 pt Graslan L
Spring or Fall. Apply in spring or early summer before wormwood is over 12 inches. Tordon alone or Tordon plus 2,4-D has provided excellent results in SDSU tests. Results on larger plants have been better than for 2,4-D. Promising as a fall treatment.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH):
0.5-0.75 pt Tordon + 1 lb ae 2,4-D, 2- 4 pt (2.54L), or 1.25-2.66 pt Graslan L
Spring: Apply at the seedling or rosette stage. Use Tordon at 0.5-0.75 pt plus 2,4-D at 1 lb ae/A for spring application. Provides excellent control under a wide range of growing conditions. Visual effects develop more slowly than for some treatments. Apply 2 pt Trooper P+D or 1.25 pt Graslan L to rosettes or 3-4 pt Trooper P+D or 2-2.66 pt Graslan L from bolting to bud stage.

CANADA THISTLE: 1-2 pt Tordon + 1 lb ae 2,4-D ester, 2-3 qt (2.54L), or 1.25-2 qt Graslan L
Spring. Intended as a multi-year program with sufficient seasonal suppression so only one application per season is required. Apply at bud stage before flowers open. Amines cause less leaf burn and are preferred if growth is lush. Some fall regrowth may be noted in wet seasons. Lower rates do not provide sufficient residual control into the fall.

CHICORY: 1 pt Tordon + 1 lb ae 2,4-D, 2-4 pt (2.54L), or 1.25-2.66 pt Graslan L
Spring. Apply to young and actively growing plants. Apply from the rosette to early bud stage.

COMMON MULLEIN: 1-1.5 pt Tordon + 1 lb ae 2,4-D ester, 4 pt (2.54L) or 2.66 pt Graslan L
Spring or Fall. Apply at rosette stage prior to stalk elongation. Apply to rosettes in the spring or fall before bolting. Treatments have exceeded 90% control in tests in western South Dakota. Surfactant improves penetration through woolly leaf surface. Reduction is apparent for at least 2 years.

FIELD BINDWEED: 1 qt Tordon + 1 lb ae 2,4-D ester, 2-3 qt (2.54L), or 1.25-2 qt Graslan L
Spring. Amine formulation of 2,4-D may be used if site limitations preclude ester formulations. Intended as one application per year; some regrowth may be noted. Follow-up treatments may be required after 1 year.

HOUNDSTONGUE: 1 pt Tordon + 1 lb ae 2,4-D ester, 4 pt (2.54L) or 2.66 pt Graslan L
Fall or Summer. Apply to rosettes in late fall or early summer. Surfactant improves penetration through woolly leaf surface.

LEAFY SPURGE: 1-2 pt Tordon + 1 lb ae 2,4-D ester, 1.2-2.5 qt Graslan L
Spring. Tank-mix. Intended as a 4 to 5 year program. Apply in late bud stage. Amine formulation of 2,4-D may be used if site limitations preclude ester formulations. Intended as one application per year; some regrowth may be noted in wet seasons. Treatment has provided 75 to 80% leafy spurge stand reduction after 4 years.

OXEYE DAISY: 1.5 pt + 1 lb ae 2,4-D, 3-4 pt (2.54L), or 2-2.66 pt Graslan L
Spring. Apply while plants are actively growing. Apply after plants have emerged to late flowering. It is recommended to use at least 30 gallons water per acre to ensure thorough coverage. May mix lower rate with 2,4-D at 1 lb ae/A.

POISON HEMLOCK: 2-4 pt (2.54L) or 1.25-2.66 pt Graslan L
Spring or Fall. Apply to rosette stage up to 36 inches.

ST. JOHNSWORT: 1-2 pt Tordon + 1 lb ae 2,4-D
Spring or Fall. Has provided excellent control in SDSU tests. Spring application at bud stage gave 95% control for a 2-year period. Reduce the Tordon rate to 0.5 pt/A when used with 2,4-D if conditions are favorable. Control has averaged 90 to 95% for one year.

TOADFLAX (DALMATIAN): 1 qt Tordon + 1 lb ae 2,4-D ester
Late summer (flowering) or Fall. For Dalmatian toadflax, apply to actively growing plants through the full bloom stage or in late summer or fall. Use Tordon in tank-mix with 2,4-D in spring before full bloom.

2,4-D ESTER or AMINE

1-3 lb ae 2,4-D ester or amine 4L **($3.05-14.65)**
2-4 pt Freelexx (1-2 lb ae)

Selective, foliage applied, translocated herbicide. Uses for 2,4-D include grass pasture, range, and non-crop areas. Low-volatile ester formulations are preferred for grass pasture and roadsides. Use amine formulations near trees or where vapor-drift risk is critical for sensitive plants. Freelexx is formulated as choline salt for low volatility with similar use sites and target weeds as many 2,4-D amine products. Minimum carrier is 10 gpa for ground. For aerial application; minimum carrier is 3 gpa for Freelexx or 2 gpa for other products. Apply when expected high temperature is to exceed 65°F.

FORMULATION CONVERSIONS

Rates for 2,4-D are stated as acid equivalent (ae) per acre. The amount of product for several rates is listed for each formulation.

2,4-D RATE Product Per Acre

Lb/A Required	3.8L*	5.7L*	FORMULATION	
			80% WSP	90% WSP
0.5	1 pt	0.66 pt	0.66 lb	0.6 lb
1.0	2 pt	1.33 pt	1.25 lb	1.1 lb
1.5	3 pt	2 pt	1.9 lb	1.7 lb
2.0	4 pt	2.66 pt	2.5 lb	2.2 lb
*2,4-D showing 3.8 lb/gal is the same as 4 lb/gal; and 5.7 lb/gal is the same as 6 lb/gal acid equivalent.				

Restrictions: Avoid drift to trees and sensitive crops. Not suggested for use in trees. Even products that claim "low volatility" still have the potential to volatilize. Volatilization may be slightly reduced if applied when temperatures are less than 85°F. Do not graze lactating dairy animals for 7 days after application. Labels for 2,4-D allow harvesting hay 7 days after application and require a 3 day removal period before slaughter. Note other label precautions.

Several amine formulations may be registered for use in water, but ester formulations usually are not. Labels for 2,4-D products vary, so always verify appropriate registrations on the product labels before applying in water. See "2,4-D Label Registrations and Non-crop Labeling" table in this guide for more information.

ABSINTH WORMWOOD (WORMWOOD SAGE): 2 lb ae ester or amine, 2-4 pt Freelexx
Spring or Fall. Apply when wormwood is 8 to 10 inches tall. Rate is 2 lb ae/A. Control is variable. Good coverage improves control.

BIENNIAL THISTLES (MUSK & BULL): 1.5-2 lb ae ester or amine, 2-4 pt Freelexx
Spring. Apply at rosette stage. May be used in fall or spring; however, other fall treatments with soil residual activity may be more effective. The low rate has been satisfactory under ideal conditions; 2 lb/A is most consistent. Esters are preferred for pastures; use amines when spraying near trees. Control is reduced after flower stalks elongate (bolt).

BURDOCK: 1 lb ae amine, 2-4 pt Freelexx
Spring or Fall: Apply while burdock is in the rosette stage and actively growing. Consider making applications to rosettes in the fall to avoid tree injury.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 1.5-3 lb ae ester or amine, 2-4 pt Freelexx
Late Fall 2-3 lb ae amine: Apply a high rate in late fall before leaves are damaged by frost. Rates to 2 lb ae/A may be used in pasture and range; higher rates are allowed in non-crop and fallow. Data indicate 50 to 60% stand reduction if there is considerable new growth and if weeds have been weakened by previous control practices. Light frost before application does not reduce control; temperatures of 60°F after application improve results.

Spring and Fall 1.5 lb ae amine or ester: Requires a spring and fall application each year. Make spring applications at bud stage. Retreat in September or early October after new fall growth reaches 6 inches. Results can be variable.

One spraying prevents seed production. Two applications provided 10 to 25% stand reduction the first year in SDSU tests. Reductions of 70 to 80% may be achieved after 3 years. This is a popular program for large infestations in pasture and roadsides. However, several years are required to reach high levels of eradication. Amine formulations are suggested for spring treatments when growth is lush. Esters may be used for fall spraying or if plants are stressed. Fall retreating is critical.

CHICORY: 2 lb ae ester or amine, 2-4 pt Freelexx
Spring. Apply to young and actively growing plants.

FIELD BINDWEED: 1.5-2 lb ae ester, 2-4 pt Freelexx
Spring and Fall. Spring and fall application required each year. Selective, foliage applied, translocated herbicide. Apply 2,4-D ester at 1.5 lb ae/A. Apply in spring at flowering and retreat in September or early October when new fall growth is 4 to 6 inches. Results can be variable.

Spring or Fall. Single application each year. Rates to 2 lb/A may be used in pasture and range; higher rates are allowed in non-crop and fallow. Control is less than for two applications of 1.5 lb/A each. Best for inaccessible areas where the labor cost for a second application is prohibitive.

KNAPWEED SPECIES: 2 lb ae ester
Spring. Apply at rosette stage. Rate of 2 lb ae/A has provided 95 to 99% control in several SDSU tests. Lower rates may be adequate under ideal conditions.

LEAFY SPURGE: 1.5-2 lb ae ester
Spring and Fall. Spring and fall application required each year. Apply 2,4-D ester at 1.5 lb ae/A. This treatment has been popular for large infestations; however, several years are required to achieve significant stand reduction. Apply in spring at late bud stage when bracts begin to yellow. Retreat in September or early October when new fall growth is 4 to 6 inches. Results can be variable. One treatment per year prevents seed production. Stands have been reduced 50% in 3 years. Complete eradication is difficult even after 10 years. Surfactant or fuel additives increase leaf burn but seldom increase stand reduction.

Spring or Fall. Single application each year. Rates to 2 lb/A may be used in pasture and range; higher rates are allowed in non-crop and fallow. Control is less than for two applications of 1.5 lb/A each. Best for inaccessible areas where the labor cost for a second application is prohibitive.

MILESTONE *(aminopyralid)*

3-7 oz Milestone (0.05-0.11 lb ai) **($7.55-17.60)**

May be used in pastures, rangeland, CRP, and non-crop areas. Avoid mowing for 14 days after application to allow for herbicide translocation in the weeds. Recommended minimum carrier volume is at least 10 gpa for ground application or at least 2 gpa for aerial application. Greater carrier volumes may improve coverage and control. Use a non-ionic surfactant (NIS) at 0.25-0.5% under adverse growing conditions or advanced weed growth stages.

Restrictions: Do not apply Milestone at more than 7 fl oz (0.11 lb ae) per acre per year for broadcast applications or 14 fl oz (0.22 lb ae) for spot treatments (less than ½ acre areas). See label for off farm distribution/sale of hay or harvested forage use. There are no grazing restrictions, but allow animals to graze for 3 days on an untreated pasture before moving to areas with sensitive broadleaf crops as aminopyralid may be transferred in manure from livestock. Do not spread manure on areas used for broadleaf crops if animals have grazed treated areas or consumed aminopyralid treated forage or hay. A field bioassay is required before a broadleaf crop can be planted on areas that were treated the previous year with manure from animals that have grazed or eaten treated hay. Do not rotate to cropland for at least one year after application (may require at least 2 years for broadleaf crops).

Milestone may be applied to non-irrigation ditch banks and seasonally dry wetlands, but may not be applied over water or to areas where surface water is present. After grass planting, wait until perennial grasses are well established with a secondary root system before applying Milestone. Some grasses, such as smooth brome, may be suppressed under adverse growing conditions.

Although Milestone may be applied around some mature tree species, some species are sensitive. The table below lists trees that are sensitive or tolerant to Milestone. However, even tolerant trees may be susceptible to injury if excessive rates are applied over the roots, exposed roots at the soil surface become exposed to Milestone, or Milestone is exposed to leaves or thin bark. Milestone should never be applied over the top of any tree species. In general, Stinger or Transline are often safer around trees than Milestone. The trees listed below are not listed on the Milestone label, but are listed on the Corteva website. Therefore, this is not an official recommendation. Applicators are responsible for any tree injury that may occur.

Tree species tolerance to Milestone

Tolerant trees (May use under canopy.)	Semi-tolerant trees (May apply outside the dripline.)	Sensitive trees (Do not use.)
Ash	Birch	Black or Honey locust
Aspen	Douglas fir	Caragana
Black cherry	Fir	Cedar *(Thuja spp.)*
Cottonwood	Hackberry	Junipers
Dogwood	Lodgepole pine	Lilac
Eastern Red Cedar	Ponderosa pine	Mimosa
Eastern white pine		Pinyon pine
Elm		Redbud
Maple		Rose
Oaks		Spruce *(Picea spp.)*
Willow		
Yellow poplar		

ABSINTH WORMWOOD (WORMWOOD SAGE): 6-7 oz

Spring or Fall: Apply at 6-7 fl oz/A before wormwood is 12 inches tall. May see reduced control with later applications, particularly in drought stressed conditions. Removal of old grass litter by mowing or burning may improve coverage and wormwood control.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH): 3-5 oz musk, plumeless, or bull; 5-7 oz scotch

Spring or Fall. Apply in the spring or summer to plants in the rosette or bolting stages of growth or in the fall to seedlings or rosettes. Use 3-5 oz for musk, plumeless or bull thistle and 5-7 oz for scotch thistle. Use higher rates when plants are in the late bolting through early flowering growth stages. Milestone control after the late bud stage may be improved by tank-mixing 2,4-D at 1 lb ai/A.

BLACK HENBANE: 5-7 oz

Spring. Apply to actively growing plants in the rosette growth stage.

BURDOCK: 4-7 oz

Spring or Fall: Apply while burdock is in the rosette stage and actively growing. There is risk of tree root uptake if tree roots are exposed or excessive rates used.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 3-5 oz perennial sowthistle; 5-7 oz Canada thistle

Spring or Fall. Apply at 5-7 oz/A for Canada thistle or 3-5 oz/A for perennial sowthistle. Make applications in early summer at the bud stage or early flowering or in fall prior to a killing frost. Use higher rates for advanced weed growth stages, dense stands, or under adverse growing conditions, such as drought. SDSU studies have demonstrated excellent control that may last two or more years.

COMMON MULLEIN: 7 oz
Spring: Apply at the rosette stage. Full coverage and use of a surfactant is necessary for best results. Control has been very good in SDSU trials.

GIANT KNOTWEED: 7 oz
Fall. Mow giant knotweed in the summer and apply 7 oz/A in the fall before frost. Allow at least 3 feet of regrowth before application. May apply 14 oz/A as a spot treatment.

KNAPWEED SPECIES: 5-7 oz
Spring or Fall. Apply to diffuse or spotted knapweed that is actively growing in the rosette to bolting stage or in the fall. Apply to Russian knapweed in the spring and summer when plants are in the bud to flower growth stage.

OXEYE DAISY: 4-6 oz
Spring. Apply in the spring at the pre-bud growth stage.

ST. JOHNSWORT: 5-7 oz
Spring or Fall. Apply in the spring at the bud growth stage or in the fall to regrowth.

SULFUR CINQUEFOIL AND CHICORY: 4-6 oz
Spring: Apply to actively growing plants in the pre-bud growth stage.

GRAZONNEXT HL or FOREFRONT HL *(aminopyralid+ 2,4-D)*

1.2-2.1 pt GrazonNext HL or ForeFront HL (0.06-0.11 + 0.5-0.87 lb ae) ($7.85-13.70)

May be used in pastures, rangeland, CRP and non-crop areas. Use a non-ionic surfactant (NIS) at 0.25-0.5% under adverse growing conditions or advanced weed growth stages. Recommended minimum carrier volume is at least 10 gpa for ground application or at least 2 gpa for aerial application. Greater carrier volumes may improve coverage and control.

Restrictions: Do not mow or harvest forage for hay within 7 days after application, allow 14 days for herbicide translocation in the weeds. Treatment may increase palatability of poisonous plants; do not graze until plants are dry and no longer palatable to livestock. See label for off farm distribution/sale of hay. Do not apply more than 2.1 pt/A in a growing season. Allow 30 days between applications. Do not apply around trees unless injury due to root uptake is acceptable. Do not apply over the top of trees and avoid leaf contact. There are no grazing restrictions, but allow animals to graze for 3 days on an untreated pasture before moving to areas with sensitive broadleaf crops as aminopyralid may be transferred in manure from livestock. Do not spread manure on areas used for broadleaf crops if animals have grazed treated areas or consumed aminopyralid treated forage or hay. A field bioassay is required before a broadleaf crop can be planted on areas that were treated the previous year with manure from animals that have grazed or eaten treated hay. Do not rotate to cropland for at least one year after application (may require at least 2 years for broadleaf crops).

ABSINTH WORMWOOD (WORMWOOD SAGE): 1.2-1.5 pt
Spring or Fall: Apply before wormwood is 12 inches tall. May see reduced control with later applications, particularly in drought stressed conditions. Removal of old grass litter by mowing or burning may improve coverage and wormwood control.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH):
1.2-1.5 pt bull, musk, plumeless; 1.5-2.1 pt scotch
Spring or Fall. Apply in the spring or summer to plants in the rosette or bolting stages of growth or in the fall to seedlings or rosettes. Apply 1.2-1.5 pt for musk, plumeless, or bull thistle and 1.5-2.1 pt for scotch thistle. Use higher rates when plants are in the late bolting through early flowering growth stages.

BURDOCK: 1.5-2.1 pt
Spring or Fall: Apply while burdock is in the rosette stage and actively growing. There is risk of tree root uptake if tree roots are exposed or excessive rates used. Consider making applications to rosettes in the fall to reduce tree injury.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 1.5-2.1 pt
Spring or Fall. Apply at 1.5-2.1 pt/A for either species. Make applications in early summer at the bud stage or early flowering or in fall prior to a killing frost. Use higher rates for advanced weed growth stages, dense stands, or under adverse growing conditions, such as drought. SDSU studies have demonstrated excellent control that may last two or more years.

COMMON MULLEIN: 1.5-2.1 pt
Spring. Apply at the rosette stage. Full coverage and use of a surfactant is necessary for best results. Control has been very good in SDSU trials.

KNAPWEED SPECIES: 1.5-2.1 pt
Spring or Fall. Apply to diffuse or spotted knapweed that is actively growing in the rosette to bolting stage or in the fall. Apply to Russian knapweed in the spring and summer when plants are in the bud to flower growth stage.

OXEYE DAISY: 1.2-1.5 pt
Spring. Apply in the spring at the bud growth stage.

ST. JOHNSWORT: 1.5-2.1 pt
Spring or Fall. Apply in the spring at the bud growth stage or in the fall to regrowth.

SULFUR CINQUEFOIL AND CHICORY: 1.2-1.5 pt (cinquefoil), 1.5-2.1 pt (chicory)
Spring. Apply to actively growing plants in the pre-bud growth stage.

WHITE HOREHOUND: 1.5-2.1 pt
Spring. Provides suppression only. Apply to actively growing plants. Full coverage and use of a surfactant is necessary for best results.

CHAPARRAL or OPENSIGHT *(aminopyralid+ metsulfuron)*

1-3.3 oz Chaparral or Opensight (0.03-0.11 lb ae + 0.006-0.02 lb ai) ($6.00-19.90)

May be used in pastures, rangeland, CRP and non-crop areas. Recommended minimum carrier volume is at least 10 gpa for ground application or at least 2 gpa for aerial application. Greater carrier volumes may improve coverage and control. Add NIS (0.25-0.5% v/v), COC (1-2% v/v), or MSO (0.5% v/v). May also add UAN (2-4 qt/A) or AMS (2-4 lb/A).

Restrictions: If possible, do not hay until 14 days after application to allow the herbicide to become active in the weed. Do not apply more than 3.3 oz per acre per year for broadcast applications or 6.6 oz for spot treatments (less than ½ acre areas). See label for off farm distribution/sale of hay. There are no grazing restrictions, but allow animals to graze for 3 days on an untreated pasture before moving to areas with sensitive broadleaf crops as aminopyralid may be transferred in manure from livestock. Do not spread manure on areas used for broadleaf crops if animals have grazed treated areas or consumed aminopyralid treated forage or hay. A field bioassay is required before a broadleaf crop can be planted on areas that were treated the previous year with manure from animals that have grazed or eaten treated hay. Do not rotate to cropland for at least one year after application (may require at least 2 years for broadleaf crops). Not as safe around trees as Stinger. Do not apply around trees unless injury due to root uptake is acceptable. Do not apply over the top of trees and avoid leaf contact. Risk of tree injury is less for large trees. Sensitive trees include some conifers (pine, fir, spruce), legume trees such as locust, birch, lilacs, and possibly hackberry. Do not apply near young trees.

ABSINTH WORMWOOD: 3-3.3 oz
Spring or Fall. Apply in the spring to wormwood up to 12 inches tall. Apply to green regrowth in the fall. A minimum of 3 GPA is recommended for aerial application on CRP for adequate coverage.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH):
1-2.5 oz bull, musk, plumeless, 1.5-2.5 oz scotch
Spring or Fall. Apply 1-2 oz in the spring or summer to plants in the rosette or bolting stages of growth or in the fall to seedlings or rosettes. Use 2-2.5 oz plus 0.5 lb ae 2,4-D when plants are in the late bolting through early flowering growth stages.

BLACK HENBANE: 2.5-3 oz
Spring. Apply to actively growing plants in the rosette growth stage.

BURDOCK: 2-2.5 oz
Spring or Fall. Apply while burdock is in the rosette stage and actively growing. Chaparral will not volatilize, but there is risk of tree root uptake if tree roots are exposed or excessive rates used.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 2-3.3 oz Canada thistle, 2-2.5 oz perennial sowthistle
Spring or Fall. Apply in the spring from early budding to full flower stage. Use higher rate for flower stage. Apply in the fall before a killing frost. For older/dense stands or for longer residual use the higher rate.

COMMON MULLEIN & HOUNDSTONGUE: 2-3.3 oz (common mullein), 2.5-3.3 oz (houndstongue)
Spring. Apply the low rate at the rosette stage. For bolting mullein less than 12 inches use 2.5-3.3 oz. For houndstongue from bolting to early bud stage use 3-3.3 oz and tank-mix with 1 qt 2,4-D after the bud stage. Full coverage and use of a surfactant is necessary for best results. Control has been very good in SDSU trials.

COMMON TANSY: 2.5-3.3 oz
Spring, early summer. Apply to actively growing plants.

HOARY CRESS: 3.3 oz
Spring. Apply to actively growing rosettes or to regrowth before bud stage. For treatment after bloom add 2,4-D at 1 lb ae/A. Can be applied in the fall to regrowth before the first killing frost.

KNAPWEED SPECIES: 2.5-3.3 oz
Spring or Fall. Apply to diffuse or spotted knapweed that is actively growing in the rosette to bolting stage or in the fall. Apply to Russian knapweed in the spring or summer when plants are in the bud to flower growth stage or to dormant plants in the fall.

OXEYE DAISY: 2.5-3.3 oz
Spring. Apply in the spring at the pre-bud growth stage.

ST. JOHNSWORT: 2.5-3 oz
Spring or Fall. Apply in the spring at the bud growth stage or in the fall to regrowth.

SULFUR CINQUEFOIL AND CHICORY: 2-2.5 oz (cinquefoil), 1.5-2 oz (chicory)
Spring. Apply to actively growing plants in the pre-bud growth stage.

CAPSTONE *(aminopyralid+ triclopyr)*

4-9 pt Capstone (0.05-0.113 + 0.5-1.125 lb ae) ($22.00-49.50)

Capstone is labeled for use in pastures, rangeland, CRP and non-crop areas. Recommended minimum carrier volume is at least 10 gpa for ground application or at least 2 gpa for aerial application. Greater carrier volumes may improve coverage and control. Use a non-ionic surfactant (NIS) at 0.25-0.5% under adverse growing conditions or advanced weed growth stages.

Restrictions: Do not contaminate irrigation ditches. Do not apply more than 9 pt/A per year on non-crop areas. See label for off farm distribution/sale of hay or harvested forage use. There are no grazing restrictions, but allow animals to graze for 3 days on an untreated pasture before moving to areas with sensitive broadleaf crops as aminopyralid may be transferred in manure from livestock. Do not spread manure on areas used for broadleaf crops if animals have grazed treated areas or consumed aminopyralid treated forage or hay.

ABSINTH WORMWOOD: 4-6 pt
Spring or Fall. Apply before wormwood is 12 inches tall. May see reduced control with later applications, particularly in drought stressed conditions.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH): 4-6 pt
Spring or Fall. Apply 4-6 pt to rosette or bolting plants in the spring and early summer or to seedlings and rosettes in the fall. Apply 5-6 pt to plants that are at the late bolt to early flowering stages.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 8-9 pt Canada thistle; 4-6 pt perennial sowthistle
Spring or Fall. Apply 8-9 pt to Canada thistle in the spring after emergence to full flower stage. Use the higher rate for flowering plants. Fall applications may also be made before a killing frost. Apply 4-6 pt to actively growing perennial sowthistle.

CHICORY: 4-6 pt
Spring. Apply to actively growing plants in the pre-bud growth stage.

COMMON MULLEIN: 4-6 pt
Spring. Apply at the rosette stage. Full coverage and use of a surfactant is necessary for best results.

KNAPWEED SPECIES: 5-9 pt
Spring or Fall. For diffuse and spotted knapweeds; apply 6-9 pt to actively growing plants from rosette to bolting stages or in the fall. For Russian knapweed; apply 5-8 pt in the spring and summer to the bud to flowering stage or to dormant plants in the fall.

OXEYE DAISY: 5-8 pt
Spring. Apply to actively growing plants in the pre-bud growth stage.

SULFUR CINQUEFOIL: 5-8 pt
Spring. Apply to actively growing plants in the pre-bud growth stage.

STINGER or TRANSLINE *(clopyralid)*

0.25-1.33 pt Stinger or Transline 3L (0.09-0.5 lb ae) ($4.60-91.00)

Clopyralid is available in several brand name products, including **Bite**, **Clean Slate**, **Clopyralid 3**, **Spur**, **Stigmata**, **Stinger** and **Transline**. Formulation and use may vary. Follow directions for product used. Stinger is labeled for use in grass pasture, rangeland, CRP, fallow, fencerows, and other non-crop areas. Transline is labeled for non-crop areas, pasture, rangeland, CRP, fencerows, and rights-of-way. Stinger or Transline have potential in sites where grass cannot be damaged or where trees limit use of herbicides with harmful soil residual, such as Tordon (picloram) or Milestone (aminopyralid). Minimum carrier is 2 gpa; use at least 10 gpa for most ground applications.

Restrictions: Do not contaminate irrigation ditches. No grazing or haying restrictions. Do not apply over the top of deciduous trees and avoid leaf contact. Risk of tree injury is less for large trees. Avoid spray contact on the bark of young trees. There are no grazing restrictions, but allow animals to graze for 7 days on an untreated pasture before moving to areas with sensitive broadleaf crops as clopyralid may be transferred in manure from livestock. Do not spread manure on areas used for broadleaf crops if animals have grazed treated areas or consumed clopyralid treated forage or hay.

BIENNIAL THISTLES (MUSK & BULL): 0.33-1.33 pt
Spring. Apply from rosette to early bolt stage. Results have been very good in SDSU tests. Use the high rate for late bolt stage.

BURDOCK: 0.25-0.5 pt
Spring or Fall. Apply while burdock is in the rosette stage and actively growing. Stinger will not volatilize, but there is risk or tree root uptake if tree roots are exposed or excessive rates used.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 0.66-1.33 pt
Spring. For Canada thistle. Perennial sow thistle suppression. Apply from rosette to bud stage when plants are actively growing. Use 1 to 1.33 pt/A to achieve maximum stand reduction. Data suggest 90 to 95% reduction can be expected.

KNAPWEED SPECIES: 0.5-1.3 pt
Spring. Apply from mid bolt to late bud stage. For spotted and diffuse knapweed, apply 0.66-1 pt/A. For Russian knapweed, apply 0.67-1.3 pt/A. Use the high rate for most situations.

OXEYE DAISY: 0.25-1.33 pt
Spring. Apply while plants are actively growing. Lower rate is intended if conditions are ideal for active plant growth.

CURTAIL *(clopyralid + 2,4-D)*

1-4 qt Curtail or Commando 2.38L (0.095-0.38 + 0.5-2 lb ae) ($16.15-64.70)

Curtail is a premix containing 0.38 lb clopyralid (Stinger) plus 2 lb 2,4-D amine per gallon. Curtail is labeled for use in non-crop areas, rangeland, grass pasture, and CRP grass and fence lines. Minimum carrier is 2 gpa; use at least 10 gpa for most ground applications.

Restrictions: Do not graze lactating dairy cattle in treated areas for 14 days after application. Remove meat animal 7 days before slaughter if grazing within 2 weeks after application. Do not harvest hay within 7 days (Curtail) or 30 days (Commando) after application. Note use restriction for clopyralid (Stinger) and 2,4-D.

BIENNIAL THISTLES (MUSK & BULL): 1-2 qt
Spring. Apply at rosette to bud stage. Reduced rate of 1 qt/A is frequently used under favorable conditions.

BURDOCK: 1-2 qt
Spring or Fall. Apply while burdock is in the rosette stage and actively growing. There is risk or tree root uptake if tree roots are exposed or excessive rates used.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 2-3 qt
Spring. For Canada thistle control and perennial sowthistle suppression. Apply before bud stage when plants are actively growing. Reduced rate of 1 qt/A is frequently used for seasonal suppression. The 2 qt/A rate has provided excellent control and 60 to 70% stand reduction.

KNAPWEED SPECIES: 2-4 qt
Spring. For spotted or diffuse knapweed, apply 2 qt/A at rosette stage. For Russian knapweed suppression, apply 3-4 qt/A from early bud to mid flowering stage or in the fall to regrowth.

DICAMBA PRODUCTS *(dicamba)* RESTRICTED USE PESTICIDES.

1-2 pt dicamba 4L (0.5-1 lb ae) **($6.30-25.20)**

Dicamba is a selective, translocated herbicide. It has foliar activity. Favorable growing conditions improve results. Dicamba products are registered for use in pasture, range, CRP, and non-crop areas. Dicamba is available in several brandname products. Banvel is an example of a dimethylamine salt and Clarity is a diglycolamine salt. Diglycolamine products have less temperature and humidity restrictions for application near sensitive crops. At high rates, bromegrass may be severely stunted; bluegrass and several other grasses are tolerant. Trees, legumes, and broadleaved plants are sensitive to drift and soil residues. Minimum carrier is 3 gpa for ground or 2 gpa for air.

Restrictions: Do not apply more than 1 qt/A(4L) in a single application. Higher rates are for spot treatment only. Dicamba labeling for up to 1 pt restricts grazing lacting diary for 7 days or haying for 37 days after application. For 1 to 2 pt/A restrict grazing lactating dairy for 21 days or haying for 51 days after application. If more than 1 qt/A, do not graze lactating dairy for 40 days or harvest hay for 70 days after application. Note other label restrictions for higher rates. For some labels, allow 30 days after application before removal of animals for slaughter. Do not contaminate water.

BLACK HENBANE: 1-2 pt
Spring. Apply to actively growing plants in the rosette growth stage.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 1-2 pt
Spring or Fall. Make spring application at early bud stage. Apply in fall before a killing frost while leaves are still green. Apply 1-2 pt/A for top growth control or 2-4 pt/A for greater control as a spot treatment (50-70%).

CHICORY: 1-2 pt
Spring. Apply to actively growing plants.

FIELD BINDWEED: 1-2 pt
Spring or Fall. Make spring application at flowering or a fall application before a killing frost. Apply 1-2 pt for top growth control or 2-4 pt for spot treatment applications.

PUNCTUREVINE: 0.5-1.5 pt
Apply 0.5-1 pt to small, actively growing plants or 1-1.5 pt to established stands.

DICAMBA + 2,4-D *(dicamba + 2,4-D)*

1-2 pt dicamba 4L + 1 lb ae 2,4-D (0.5-1 + 1 lb ae) **($3.25-25.75)**
1-6 pt Brash, Weedmaster, Range Star, Rifle-D 3.87L (0.125-0.75 + 0.36-2.15 lb ae)
0.66-3.25 pt Brush-Rhap, Latigo 4.2L (0.14-0.73 + 0.2-0.98 lb ae)

Dicamba plus 2,4-D is labeled for use in grass pasture, range, and non-crop areas. Grass is usually tolerant to these rates; some stunting may be noted, especially if applied at boot stage. Brash, Weedmaster, Range Star and Rifle-D contain 1 lb ae dicamba and 2.87 lb ae 2,4-D per gallon. Brush-Rhap and Latigo contain 1.8 lb ae dicamba and 2.4 lb ae 2,4-D per gallon. Check individual label for carrier volume.

Restrictions: Refer to product labels and individual dicamba and 2,4-D restrictions.

BIENNIAL THISTLES (MUSK, PLUMELESS, & BULL):
1 pt dicamba + 1 lb ae 2,4-D, 1.5-2 pt 3.87L, or 1-1.125 pt 4.2L
Spring or Fall. Apply at the rosette stage. Use dicamba 4L at 1 pt plus 2,4-D at 1 lb ae/A. Rates as low as 0.5 pt/A dicamba have been successful under ideal conditions. Use the high rate for large rosettes, bolting plants, dense stands, or dry conditions. Apply 1-1.125 pt 4.2L or 1.5-2 pt 3.87L for bull and plumeless thistle from rosette to bolting. For musk thistle, apply 1.125 pt 4.2L or 2 pt 3.87L.

CANADA THISTLE AND PERENNIAL SOWTHISTLE:
2 pt dicamba + 1 lb ae 2,4-D, 4-6 pt 3.87L, or 2-3.25 pt 4.2L
Spring. Provides suppression only, intended as a multi-year program. Apply at bud stage. Amines cause less leaf burn and are preferred if growth is lush. Lower dicamba rates may not provide sufficient residual control into the fall, especially in wet seasons.

CHICORY: 1 pt dicamba + 1 lb ae 2,4-D ester or amine, 3 pt 3.87L, or 1.66 pt 4.2L
Spring. Apply to early bolting and actively growing plants.

FIELD BINDWEED: 4-6 pt 3.87L, or 2-3.25 pt 4.2L
Spring or Fall. Apply to actively growing plants.

KNAPWEED SPECIES (Spotted & Russian): 4-6 pt 3.87L, or 2-3.25 pt 4.2L
For spotted knapweed control or Russian knapweed suppression. Apply to actively growing plants.

POISON HEMLOCK: 1 pt dicamba + 1 lb ae 2,4-D ester
Fall or Early Spring. Apply at fall rosette stage or to new growth in early spring.

OVERDRIVE *(diflufenzopyr + dicamba)*

4-8 oz Overdrive 70DF (0.05-0.10 + 0.125-0.25 lb ae) ($10.55-21.10)

Overdrive contains dicamba. Follow drift and vapor movement restrictions as for other dicamba products. A maximum of 10 oz/A can be applied per season in non-cropland sites and a maximum of 8 ounces per acre in pasture, hay, and rangeland. Use 1 qt NIS per 100 gal or MSO at the rate of 1.5 to 2 pt/A. Do not use less than 3 gallons of spray volume per acre for ground. Minimum carrier is 2 gpa for air. Rainfast 4 hours after application. Overdrive may be tank-mixed with several labeled tank-mix partners to improve control.

Restrictions: Do not plant crops for 30 days after last application. Pasture or rangeland grass treated with Overdrive can be grazed or harvested for livestock feed immediately after application. Do not apply to newly seeded grasses or small grains.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL): 4-8 oz
Spring or Fall. Use rate is 4 to 8 oz/A based on weed species and maturity. Best results if applied at rosette stage. Use higher rates if plants are beginning to bolt.

CANADA THISTLE AND PERENNIAL SOWTHISTLE: 6-8 oz
Spring or Fall. Make spring application at early bud stage. Apply in fall before a killing frost while leaves are still green.

FIELD BINDWEED: 4-8 oz
Spring or Fall. Rate is 4 to 8 ounces per acre based on weed maturity.

KNAPWEED SPECIES: 6-8 oz
Spring or Fall. For diffuse and spotted knapweed only. Rate is 6 to 8 ounces per acre based on weed species and maturity.

OXEYE DAISY: 6-8 oz
Spring. Apply to actively growing weeds.

TELAR *(chlorsulfuron)*

0.5-2.6 oz Telar 75XP (0.023-0.12 lb ai) ($10.20-52.90)

Registered for use on non-crop, right-of-way, pasture, range, and CRP. The maximum rate for pasture/range and CRP is 1.3 oz/A per year. The maximum rate for non-crop areas is 2.6 oz/A per year. Bluestem, buffalograss, green needlegrass, Indiangrass, and switchgrass may be tolerant to Telar rates up to 0.5 oz/A whereas several wheatgrass varieties, bluegrass, and smooth bromegrass may be tolerant to rates up to 1 oz/A. Minimum carrier is 10 gpa. Add NIS at 0.25% v/v. May be mixed with 2,4-D, dicamba, or other labeled tank-mix partners for Canada thistle, biennial thistles, common mullein, houndstongue, and common tansy.

Restrictions: There are no grazing or hay harvest restrictions for rates less than 1.3 oz/A. Do not apply to water, such as lakes, streams, or areas where runoff flows into such areas.

BIENNIAL THISTLES (MUSK, BULL, & SCOTCH): 0.5-2.6 oz
Spring. Apply at rosette stage. Use 0.5 to 1 oz for musk thistle and 1 to 2.6 oz/A for bull and Scotch thistle.

CANADA THISTLE: 1-2.6 oz
Spring or Fall. Apply at bud to bloom or in fall at rosette stage. Spring application preferred.

COMMON MULLEIN & HOUNDSTONGUE: 1-2.6 oz
Spring. Apply at rosette stage. Full coverage is very important for best results.

COMMON TANSY: 1-2.6 oz
Spring, early summer. Apply to actively growing plants.

HOARY CRESS: 0.5-1 oz
Spring or Fall. Apply at bud to bloom stage in spring or in fall at rosette stage. The low rate (0.5 oz) has been very effective in SDSU trials.

KNAPWEED SPECIES: 1-2.6 oz
Spring or Fall. For Russian knapweed only. Apply at the bud to bloom growth stage in early summer or to rosettes in the fall.

POISON HEMLOCK: 1-2.6 oz
Spring. Apply in spring while plants are actively growing.

PUNCTUREVINE: 1-2.6 oz
Preemergence or Foliar applications. SDSU results have indicated greater control from PRE compared to POST applications. For PRE applications, apply in the late fall or very early spring before spring growth. Moisture is required to activate in soil. For POST applications, add NIS (0.25% v/v) or COC (1% v/v). May be used with other selective or bare ground herbicides.

TOADFLAX (DALMATIAN AND YELLOW): 1.5-2.6 oz
Late summer (flowering). Fall applications may provide more consistent control. For yellow toadflax, apply a minimum of 1.5 oz/A. For Dalmatian apply 2-2.6 oz/A. Telar (1.25 oz/A) is sometimes tank-mixed with Tordon (1 qt/A) as some yellow toadflax populations may be more sensitive to Telar than Tordon (or vice versa) or Telar may be more effective at earlier timings whereas Tordon may be more effective at later timings.

ESCORT (metsulfuron)

0.5-2 oz Escort 60XP (0.019-0.075 lb ai) **($1.50-14.00)**

Escort is labeled for range, pasture, CRP, rights-of-way, and non-crop areas. Metsulfuron is available in several other brand name products, including **Accurate**, **MSM 60** and **Patriot**. Formulation and use may vary. Follow directions for product used. Minimum of 10 gpa carrier is suggested. Add NIS at 0.25% v/v.

Restrictions: Do not apply to lakes, streams, or areas where runoff flows into such areas. Do not apply more than 1.67 oz/A per year on pasture, range or CRP. If applying more than 1.67 oz/A, do not harvest grasses for hay or forage until at least 3 days after application. Tolerance of grass species varies; limit first time use to a small area to evaluate tolerance and check label for specific information. Bluegrass, bluestem, bromegrass, grama and timothy have shown good tolerance in SDSU studies.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH): 0.5-2 oz
Spring. Apply 0.5-1 oz/A at rosette to bud growth stage to control bull, musk, or plumeless thistle or 1-2 oz/A for Scotch thistle. Control in SDSU tests has been very good with metsulfuron tank-mixed with 0.5 to 1 lb/A 2,4-D. Cold, dry conditions reduce activity. Legumes will be injured. May tank-mix 1-2 pt/A 2,4-D 3.8L.

BLACK HENBANE: 0.5-1 oz
Spring. Apply to actively growing plants in the rosette growth stage.

COMMON MULLEIN & HOUNDSTONGUE: 1-2 oz
Spring. Apply at rosette stage. Full coverage is very important. Escort at 0.5 to 1 oz/A has been effective in SDSU trials.

COMMON TANSY: 1-2 oz
Spring, early summer. Apply to actively growing plants. Good spot treatment option. Results have been very good. May be tank-mixed with 2,4-D or dicamba.

HOARY CRESS: 1-2 oz
Spring. For hoary cress control in grassland. Apply to actively growing weeds at rosette stage. Low rate (1 oz/A) has been very effective in SDSU trials.

OXEYE DAISY: 0.5-1 oz
Spring. Apply in spring while plants are actively growing or are in flower.

POISON HEMLOCK: 1-2 oz
Spring. Apply 1-2 oz/A in spring while plants are actively growing.

ST. JOHNSWORT: 1-2 oz
Spring or Fall. Apply at the bud to bloom stage; may also be applied to fall regrowth. Results from spot treatments have been excellent. May be tank-mixed with 2,4-D, dicamba, picloram, triclopyr, and clopyralid.

SULFUR CINQUEFOIL & CHICORY: 1-2 oz (cinquefoil), 0.33-0.5 oz (chicory)
Spring. May be applied up to the flowering growth stage.

TOADFLAX (DALMATIAN & YELLOW): 1.5-2 oz
Late summer (flowering). Apply to actively growing plants. Provides suppression only. Good spot treatment option; spray to wet entire plant.

CIMARRON MAX *(metsulfuron + dicamba + 2,4-D)*

20-5 Acres/5 oz Part A + 2.5 gal Part B (0.01-0.038 + 0.12-0.5 + 0.38-1.5 lb ae) ($6.35-25.35)

Cimarron Max herbicide is a twin-pak combination. Labeled for use in pasture, rangeland, CRP and grass hay. Part A contains metsulfuron (Escort). Part B contains 1 lb dicamba (Banvel) plus 2.87 lb ae 2,4-D amine per gallon. The use ratio is 5 oz Part A to 2.5 gal of Part B to treat 5 to 20 acres. The Rate II or 10 acre rate provides equivalent of 0.5 oz Escort 60XP + 0.5 pt Banvel 4L + 1.5 pt 2,4-D 3.8L per acre. Refer to following rate table for acres treated.

Cimarron Max Rate	Part A Rate (oz/A)	Part B Rate (pt/A)	Acres Treated with 5 oz Part A + 2.5 gal Part B
Rate I	0.25	1	20A
Rate II	0.5	2	10A
Rate III	1	4	5A

Add either a NIS (0.25-0.5% v/v) or COC (1-2% v/v). Use higher adjuvant rates during dry conditions. May be applied by ground or air.

Restrictions: No restrictions or waiting period between treatment and grazing for non-lactating animals. Remove meat animals 30 days prior to slaughter. Do not graze lactating dairy within 7 days of treatment. Do not harvest hay for 37 days after treatment. Do not apply more than the equivalent of 1.66 oz/A Cimarron Max Part A per year.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH):
Spring, Early Summer, or Fall. Use Rate I-III for musk and Scotch thistle prior to flowering in the spring or early summer or after newly emerged plants have reached the rosette stage in the fall but before soil freezes. Use Rate II for plumeless and bull thistle. Rates are based on weed species and weeds less than 4 inches tall.

BLACK HENBANE:
Spring. Apply Rate II to actively growing plants in the rosette growth stage.

CHICORY:
Spring. Apply Rate II to actively growing plants.

COMMON MULLEIN & HOUNDSTONGUE:
Common mullein may be controlled at Rate I and houndstongue may be controlled at the Rate III.

COMMON TANSY:
Common tansy may be controlled at Rate III.

HOARY CRESS:
Spring, Early Summer. Apply to actively growing hoary cress at Rate II with adequate soil moisture and moderate temperatures.

OXEYE DAISY:
Spring. Apply at Rate II to actively growing plants.

POISON HEMLOCK:
Fall or Spring. Apply at Rate III to fall rosettes or to new growth in early spring.

ST. JOHNSWORT:
Spring or Fall. Apply at Rate III at the bud to bloom stage; may also be applied to fall regrowth.

SULFUR CINQUEFOIL:
Spring. Apply at Rate III up to the flowering growth stage.

CIMARRON PLUS or CHISUM *(metsulfuron + chlorsulfuron)*

0.25-1.25 oz/A Cimarron Plus or Chisum (0.0075-0.038 + 0.0023-0.012 lb ai) ($2.60-13.05)

For use in pastures, rangeland, or CRP or non-crop land adjacent to these areas. Cimarron Plus and Chisum contain 48% metsulfuron + 15% chlorsulfuron. Specific labels may vary. Follow directions for product used. Add either a NIS (0.25-0.5% v/v) or COC (1-2% v/v). Use higher adjuvant rates during dry conditions. Minimum carrier is 10 gpa for ground applications or 3 gpa for aerial applications.

Restrictions: No grazing or haying restrictions.

BIENNIAL THISTLES (MUSK, PLUMELESS, BULL, & SCOTCH):

Spring. Apply in the spring (preferred) prior to flowering or to fall rosettes. Apply 0.25-0.375 oz/A for musk or Scotch thistle, 0.625 oz/A for plumeless thistle, or 1.25 oz/A for bull thistle. May tank mix growth regulator herbicides such as 2,4-D, dicamba, Tordon, or Remedy.

BLACK HENBANE:
Spring. Apply 0.625-1.25 oz/A to actively growing plants in the rosette growth stage.

CHICORY:
Spring. Apply 0.375-0.625 oz/A up to the flowering growth stage.

COMMON MULLEIN & HOUNDSTONGUE:
Spring. Apply 0.625-1.25 oz/A for common mullein or 1.25 oz/A for houndstongue. Apply at rosette stage. Full coverage is important.

COMMON TANSY:
Spring, early summer. Common tansy may be controlled with with Cimarron Plus at 1.25 oz/A.

HOARY CRESS:
Spring. Apply 1.25 oz/A to actively growing plants.

POISON HEMLOCK:
Spring. Apply 1.25 oz/A to actively growing plants.

ST. JOHNSWORT:
Spring or Fall. Apply 1.25 oz/A at the bud to bloom stage; may also be applied to fall regrowth.

SULFUR CINQUEFOIL:
Spring. Apply 1.25 oz/A up to the flowering growth stage.

METHOD *(aminocyclopyrachlor)*

8-18 oz Method 240SL (0.125-0.28 lb ae) ($21.10-47.50)
4-9 oz Method 50SG

Labeled for use in non-crop, roadsides and right-of ways. Apply to actively growing weeds. Recommended minimum carrier is 10 gpa for ground or 15-25 gpa for aerial application. May add MSO at 1% v/v or NIS at 0.25% v/v.

May injure some cool-season perennial grass species such as smooth brome and wheatgrass species. Unacceptable injury of desirable turfgrasses may result with rates above 7.5-8 oz/A(SL). See label for list of turfgrass species and rates. For grasses not listed, test a small area to determine tolerance. Spring applications may slightly reduce the risk of grass injury. Stressed grass (from drought, disease, insects, etc.) may be more susceptible to injury.

Restrictions: Non-crop use only (do not use in areas to be grazed or hayed). Do not apply to areas where roots of desirable trees may extend unless injury or loss is acceptable. Do not apply more than 0.28 lb ai per acre per year. Do not graze or feed forage, hay, or straw from treated areas. Do not use treated plant material for mulch or compost. For areas to be converted to crops, do not plant for at least one year after application (with a field bioassay).

BIENNIAL THISTLES (MUSK): 8-18 oz L or 4-9 oz SG
Spring or Fall. For Musk thistle. Apply prior to flowering in the spring (May to early June) or to rosettes in the fall (September).

CANADA THISTLE: 8-18 oz L or 4-9 oz SG
Spring, summer or Fall. Mainly for Canada thistle. Perennial sowthistle is currently not on the label, but would likely also be controlled. Slightly more effective if applied in spring or summer than fall.

FIELD BINDWEED: 12-18 oz L or 6-9 oz SG
Summer or Fall. Apply at flowering (June) or in the fall (Sept. – Oct.).

KNAPWEED SPECIES: 8-18 oz L or 4-9 oz SG
Spring or Fall. Effective on spotted, diffuse, and Russian knapweed.

LEAFY SPURGE: 8-18 oz L or 4-9 oz SG
Spring or Fall. Slightly more effective if applied in spring than fall.

POISON HEMLOCK: 12-18 oz L or 6-9 oz SG
Spring or Fall. Apply to actively growing plants.

SULFUR CINQUEFOIL: 12-18 oz L or 6-9 oz SG
Spring. Apply to actively growing plants.

TOADFLAX (DALMATIAN): 8-18 oz L or 4-9 oz SG
Late summer (flowering) or Fall. Apply to actively growing plants.

PLATEAU *(imazapic)*

8-12 oz Plateau or Panoramic 2L (0.13-0.19 lb ai) ($9.40-14.05)

Plateau is an imidazolinone herbicide used in pasture, range, non-crop areas, and CRP plantings. Minimum carrier is 10 gpa for conventional ground equipment or 2 gpa for low volume equipment.

Several tree and shrub species listed on the label are known to have acceptable tolerance when applied under the canopy and/ or to the foliage. Tolerance is based upon trees with a minimum of 2 inch DBH (diameter at breast height). Some species may exhibit tip chlorosis and minor necrosis. Foliar contact on some species may increase injury, defoliation, and terminal death.

Restrictions: Treated areas may be grazed. Do not harvest hay for 7 days after treatment. Plateau at rates greater than 8 oz/A may suppress growth of switchgrass and cool season grass species, such as smooth brome and wheatgrass.

FIELD BINDWEED: 8-12 oz
Fall. Use the higher rate for dense infestations that have been established for longer periods of time. Add MSO (1.5-2 pt/A) or NIS (0.25% v/v) and a nitrogen-based liquid fertilizer such as 28% N may also be added at 2-3 pt/A.

HOARY CRESS: 8-12 oz
Spring. Add MSO (1.5-2 pt/A) or NIS (0.25% v/v) and a nitrogen-based liquid fertilizer such as 28% N may also be added at 2-3 pt/A.

HOUNDSTONGUE & COMMON MULLEIN: 8-12 oz

Spring. Apply at the rosette stage while plants are actively growing. Plateau may also partially control common mullein, although it is only registered for houndstongue control. Add MSO (1.5-2 pt/A) or NIS (0.25% v/v) and a nitrogen-based liquid fertilizer such as 28% N may also be added at 2-3 pt/A.

KNAPWEED SPECIES (Russian): 12 oz

Fall. For Russian knapweed only. Apply in the fall after leaves begin to die back (senescence). Control may improve as senescence progresses and may still be obtained after full senescense. Apply with MSO at 1 qt/A. A NIS (0.25% v/v) may be used instead of a MSO to improve grass tolerance, but weed control may decline. In addition to MSO or NIS, UAN or AMS may be added at 2-3 pt/A to increase activity.

LEAFY SPURGE: 8-12 oz

Fall or Spring/Summer. Use the higher rate for dense infestations that have been established for longer periods of time. The lower rate has been used in most SDSU tests. Field plot data suggest follow-up control programs are required to prevent new infestations. Add MSO at 2 pt plus 2 pt/A 28% N. Results have been promising in SDSU tests; 70 to 90% control has been reported the year after application. Fall treatment to active growth has been more effective than spring applications. If a light frost has occurred, check for milky sap before application. A tank- mix with **Detail** (saflufenacil) is useful to improve control. Use 1-2 oz/A **Detail** plus 4-6 oz/A Plateau and apply to leafy spurge at the yellow bract stage in late spring/early summer. Do not apply tank-mix in the fall as it may result in unsatisfactory control. Use NIS at 0.25% v/v and AMS at 8.5-17 lb/100 gal. COC or MSO may be used however grass injury (necrosis, stunting) will be increased.

PUNCTUREVINE: 8-12 oz

Spring or early summer. Apply to actively growing plants.

TOADFLAX (DALMATIAN): 8-12 oz

Late summer (flowering). Label recommends 12 oz/A of Plateau plus 2 pt/A MSO for control of dalmatian toadflax. In addition to MSO, UAN or AMS may be added at 2-3 pt/A. For best results, apply to the basal growth in the fall, after the first hard frost. The plant can have the top 25% showing necrotic tissue; however, there should be green stem and leaf tissue remaining. Applications made prior to this timing will result in poor control.

GARLON 4 or GARLON 4 ULTRA *(triclopyr ester)*

1-2 pt Garlon 4L (0.5-1 lb ae) **($12.90-25.75)**

For use in non-crop, roadsides and right-of-ways. Garlon is recommended for the control of unwanted woody plants and broadleaf weeds. Basal bark or cut stump treatments are most effective for woody plants.

Restrictions: No grazing restrictions for non-lactating animals. Do not allow lactating dairy animals to graze treated areas until the next growing season. Do not harvest hay for 14 days. Do not apply more than 2 qt/A per season on rights-of-way or areas that are grazed or harvested. May use up to 8 qt/A on grazed right-of-way areas as long as treated area is no more than 10% of total grazed area. Do not exceed 8 qt/A per year on non-crop areas. Do not apply in ditches or canals used to transport irrigation water. Do not apply where runoff water may flow onto agricultural land. May be applied to seasonally dry wetlands where surface water is not present.

SULFUR CINQUEFOIL & CHICORY: 1-2 pt

Spring. Apply to rosette stage.

REMEDY ULTRA *(triclopyr ester)*

1-2 pt Remedy Ultra 4L (0.5-1 lb ae) **($9.35-18.70)**

Labeled for use in pasture, rangeland, fencerows, and CRP.

Restrictions: No grazing restrictions. Do not harvest hay for 14 days after application. Withdraw livestock from treated areas at least 3 days prior to slaughter.

SULFUR CINQUEFOIL & CHICORY: 1-2 pt
Spring. Apply to young plants in the rosette stage.

FACET or QUINSTAR *(quinclorac)*

22-32 oz Facet 1.5L (0.25-0.38 lb ai) **($12.05-31.50)**
0.5-0.75 pt QuinStar 4L

Labeled for use in pasture, rangeland, rights-of-way, non-crop, and CRP. Controls annual grass but does not cause permanent damage to most perennial grasses. Apply with ground or air equipment (note restrictions). Add 2 pt COC or 1-2 pt MSO; may also add 0.5 to 1 gal 28% N or 2.5 lb AMS per acre.

Restrictions: There are no grazing restrictions. Do not harvest hay or forage for 7 days. Follow crop rotation restrictions for fallow application. Aerial applications not allowed in Bennett, Brookings, Brown, Clay, Codington, Day, Deuel, Grant, Lincoln, Minnehaha, Moody, Roberts, Todd, Turner, Union, or Yankton counties.

FIELD BINDWEED: 22-32 oz Facet or 0.5-0.75 pt QuinStar 4L
Fall. Primarily for field bindweed. Also suppresses leafy spurge and perennial thistle. Most effective if applied in fall to regrowth at least 4 inches long. Make follow-up applications the next year if necessary. Apply to active weed growth. Use higher rate for dense populations or large weeds.

GLYPHOSATE PRODUCTS

0.38-3 lb ae glyphosate ($1.40-21.65)

Can be used in pasture, rangeland, CRP, right-of-way, and non-crop. Individual labels may vary. Can be used for spot treatment, wiper applications, or pasture renovation. Controls many annual and perennial plants. Rates are 11 oz to 3.3 qt (0.38-3.7 lb ae) of 4.5 lb ae glyphosate per acre. Adjust rates for other formulations.

Rates of 0.38-0.75 lb ae are used for most annual weeds; most perennials require 1.5-3 lb ae per acre. Perennial grasses to be controlled in renovation programs require 1.5-2.25 lb ae for most situations. Retreatment may be required for tolerant species. Spot treatment can be used in bluegrass, brome, orchardgrass, wheatgrass, alfalfa and clover. Minimum carrier is 3 gpa.

Restrictions: Will kill or severely injure all green vegetation contacted by the herbicide. Avoid spray contact on bark of young trees.

Pasture renovation: No restrictions with rates of 2.25 lb ae/A or less (consult individual product label). With rates above 2.25 lb ae/A, remove livestock before application and do not harvest or graze livestock for 8 weeks.

Refer to the glyphosate formulation table below to determine product rate for other formulations.

GLYPHOSATE PRODUCTS – Equivalent Rates

	Amount of Product for lb ae			
Formulation	0.38 ae	0.75 ae	1.5 ae	3 ae
3 lb ae (4 lb ai)	16 oz	32 oz	64 oz	128 oz
4 lb ae (5.4 lb ai)	12 oz	24 oz	48 oz	96 oz
4.5 lb ae (5.5 lb ai)	11 oz	21 oz	43 oz	85 oz

SHELTERBELTS
(Does not include fruit trees)

GLYPHOSATE PRODUCTS

2-4 qt glyphosate 3 lb ae (1.5-3 lb ae) **($5.70-11.40)**

Glyphosate is formulated in different salts and different concentrations. Rates for formulations are listed according to acid equivalent content. Check specific product labeling. Roundup Pro labeling includes tree plantings and non-crop sites. Other products limit use to trees and non-crop areas associated with agricultural sites. Product concentration also varies.

Glyphosate is a nonselective, foliar, translocated herbicide. There is no soil residual activity.

Restrictions: Avoid spray or drift contact on green leaves, stems, or new bark. Note other label precautions.

Spring or fall. Apply when weeds are actively growing and at boot or bud to bloom stage. Fall application is more effective than spring. Canada thistle is reduced 75 to 85%; field bindweed 50 to 75%. Field bindweed control is more variable. Apply in 10 to 40 gpa carrier. Rates are 3 qt for Canada thistle, and 4 qt of 3L ae/A for field bindweed. Adjust rates for other formulations.

BURDOCK:
Spring or Fall. Apply while burdock is in the rosette stage and actively growing.

2,4-D AMINE

1-1.5 lb ae 2,4-D **($3.05-7.30)**

Spring or fall. Selective, translocated herbicide for broadleaf weeds. This herbicide is useful to reduce stands of perennial weeds including absinth wormwood, biennial thistles, burdock, field bindweed, Canada thistle, perennial sowthistle, common mullein, houndstongue, knapweeds, puncturevine, sulfur cinquefoil, chicory or leafy spurge. Labeling is for non-crop areas; tree uses are not listed. Apply when weeds are actively growing and at bud stage. Requires retreatment in fall. Apply 1 to 1.5 lb ae 2,4-D amine/A. Suggested carrier is 40 gpa. Use no more than 20 psi pressure to produce coarse droplets and reduce risk of drift. Spray when it's calm and expected high temperature is below 75°F.

Restrictions: Very small amounts of herbicide from vapor or droplet drift can seriously damage or kill deciduous trees. Some leaf burn may be noted. Conifers are somewhat less sensitive, especially when not actively growing. Avoid heavy application over tree root zone. Suggested use is limited to special situations where risk of exposure to trees can be assumed. Labelers will not be responsible for damage to trees.

PLATEAU *(imazapic)*

8-12 oz Plateau 2L (0.12-0.19 lb ai) ($9.40-14.05)

Preemergence and foliar applications. Labeled for use in approved brush and tree species. Not intended for use on nursery, orchard, ornamental plantings, new plantings, or seedling trees. Plateau controls bull thistle, musk thistle, houndstongue, field bindweed, hoary cress, Russian knapweed, leafy spurge, puncturevine, and Dalmatian toadflax.

Early post-emergence suggested for most weeds; however, there is residual activity for preemergence effect. Always add (MSO) at 1.5 to 2 pt when using less than 30 gpa carrier. For carrier over 30 gpa, use MSO or COC at 1 gal/100 gal. UAN or AMS may also be added at 2 – 3 pt/A. NIS may be used in place of seed oil in some situations to reduce grass injury, but weed control may also decline. Apply Plateau as a directed spray below the foliage for best selectivity. Some chlorosis may be noted. Plateau may be mixed with Pendulum or other herbicides approved for use.

Restrictions: Suggest use on a limited basis to determine tolerance. Labeled species for directed application include green ash, boxelder, red cedar, cottonwood, hackberry, juniper, locust, sugar maple, oak, white pine, serviceberry, and walnut.

Several tree and shrub species listed on the label are known to have acceptable tolerance when applied under the canopy and/ or to the foliage. Tolerance is based upon trees with a minimum of 2 inch DBH (diameter at breast height). Some species may exhibit tip chlorosis and minor necrosis. Foliar contact on some species may increase injury, defoliation, and terminal death.

STINGER or TRANSLINE *(clopyralid)*

0.25-0.66 pt Stinger or Transline 3L (0.09-0.25 lb ae) ($6.05-45.20)

Foliar applications. Labeled for over-the-top application on certain species of Christmas tree plantings, including Douglas, Fraser, grand, balsam and noble fir; blue spruce; and lodgepole, Ponderosa, and white pine. Useful to control emerged broadleaves such as bull thistle, musk thistle, burdock, Canada thistle, knapweeds, and oxeye daisy. Very effective on Canada thistle. Use the high rate for perennials. Maximum for blue spruce is 0.5 pt/A. Reports indicate good tree tolerance. Do not apply to first-year transplants. Do not use additives.

AQUATIC

AQUATIC GLYPHOSATE PRODUCT *(glyphosate)*

4-6 pt aquatic glyphosate 4L (2-3 lb ae) **($15.00-22.50)**

Aquatic glyphosate is available in several products that are approved for use on aquatic sites. Examples of products include Rodeo, AquaMaster, AquaNeat, Cinco, Glyfos Aquatic, and several others. Glyphosate is a non-selective, translocated, foliage-applied herbicide, both grasses and broadleaf plants are affected.

Aquatic glyphosate is approved for aquatic uses in lakes, streams, ponds, irrigation ditches, and reservoirs. Limit treatment to individual plants if possible. Rates for aquatic and non-crop site weeds are based on specific weeds species on the label. Use water carrier rate of 3-40 gpa. Use NIS (2 qt/100 gal) approved for aquatic use. Use a 1.5% solution (4 T/gal) for hand-held equipment.

Restrictions: Do not apply within ½ mile upstream of a potable water intake, in moving water, or within a half mile of a potable water intake in streams, ponds, or reservoirs. Allow a minimum of 7 days after treatment before reintroducing water if applying in dry ditches. There is no restriction on the use of treated water for irrigation, recreation, or domestic purposes.

EURASIAN COMMON REED (PHRAGMITES): 4-6 pt
Summer: For suppression only. Apply in late summer or fall when the plants are actively growing and in full bloom. Complete coverage is important. If old residue is inhibiting coverage, reapplication may be necessary. Visual control symptoms may be slow to develop. For hand-held sprayers, use 0.75% solution in water.

GIANT KNOTWEED:
Stem injection: Inject 5 ml of the glyphosate product into stems between the second and third internodes above the ground.

Cut stem: Cut stems just below the second or third node above the ground. Immediately apply 0.36 fl oz (10 ml) of a 50% solution of the glyphosate product and water into the "well" or the exposed internode. Do not apply more than 8 qt/A, which would be about 1,500 stems if using the 50% solution. Remove the cut giant knotweed stems so that they do not develop roots and grow.

PURPLE LOOSESTRIFE: 4 pt
Summer or fall. Apply to actively growing plants at full to late flower. Apply as a broadcast treatment at 4 pt/A or as a spot treatment using hand-held equipment with a 1% aquatic glyphosate solution (1 gal/100 gal or 3 tablespoons/gal) to thoroughly wet foliage. Late summer or fall treatments are best. Apply before killing frost. Rate is minimum required for 65 to 85% control. This plant is a perennial capable of producing new shoots from buds in the crown areas. Wild types also produce seed. Individual plants can be dug if all small crown pieces are removed. The plant is especially aggressive in wetlands.

2,4-D

1-2 lb ae 2,4-D **($3.05-8.75)**

Certain products are labeled for aquatic sites, including areas around marshes, ponds, irrigation ditches, streams, and lakes. Some products are labeled for aerial application in aquatic sites. Check labels for correct labeling. See 2,4-D table in this guide for more information. Do not apply to more than 1/3 to 1/2 of a lake or pond in any one month because excessive decaying vegetation may deplete oxygen control in water and kill fish. Do not contaminate water used for irrigation or domestic purposes. Useful for controlling Canada thistle, perennial sow thistle, leafy spurge, or other broadleaf weeds.

IMAZAPYR PRODUCTS *(imazapyr)*

1-6 pt Habitat, Ecomazapyr or Polaris 2L (0.25-1.5 lb ai) ($16.25-97.35)

Habitat is an aqueous solution to be mixed with water and surfactant approved for aquatic use. Applications of 1 to 6 pt/A may only be made to control undesirable emergent and floating aquatic vegetation in or around standing and flowing water, including estuarine and marine sites. Rates are based on aquatic weed species on the label.

Applications may be made to private waters that are still, such as ponds, lakes, and drainage ditches where there is minimal or no outflow to public waters. Applications may be made to public waters such as ponds, lakes, reservoirs, marshes, drainage ditches, canals, streams, rivers, and other slow-moving or quiescent bodies of water.

Restrictions: Do not apply more than 6 pt/A per year. Aerial application is restricted to helicopter only. May be applied to surface water, but do not apply directly to water within ½ mile upstream of an active potable water intake in flowing water or within ½ mile of an active potable water intake in a standing body of water such as lakes, ponds, or reservoirs. Habitat can only be applied by federal or state government entities or applicators who are licensed or certified applicators making applications under a program sponsored by federal or state government entities. There are no restrictions on livestock consumption of water from a treated area. Polaris has no grazing restrictions; allow 7 days after application to cut for hay.

EURASIAN COMMON REED (PHRAGMITES): 4-6 pt
Summer: Apply to actively growing foliage after full leaf elongation. Full spray coverage is important. If old plant residue is inhibiting herbicide interception, consider removing this residue by mowing or burning and wait for approximately 5 foot tall regrowth before applying the herbicide. Apply with an adjuvant such as NIS (0.25% v/v), MSO (1.5-2 pt/A or 1% v/v), or silicone-based surfactant. Be sure to use adjuvants approved for aquatic use.

FLOWERING RUSH: 2-3 pt
Apply to actively growing plants.

POISON HEMLOCK: 2 pt
Apply preemergence or early postemergence up to the rosette stage before flowering. Add 1 qt MSO.

PURPLE LOOSESTRIFE: 1 pt
Apply to actively growing foliage of purple loosestrife in and around standing and flowing water, including estuarine and marine sites. Apply with an adjuvant such as NIS (0.25% v/v), MSO (1.5-2 pt/A or 1% v/v), or silicone-based surfactant. Be sure to use adjuvants approved for aquatic use.

SALTCEDAR (TAMARIX SPECIES): 2 qt
Foliar: For aerial application (helicopter only), apply 2 qt/A + 0.25% v/v NIS to actively growing foliage during flowering. For spot spraying use 1% solution + 0.25% v/v NIS and spray to wet foliage. Wait at least 2 years after application before disturbing treated saltcedar. Earlier disturbance can reduce overall control. Can also be applied as cut stump, cut stem, and frill or girdle treatments.

VASTLAN *(triclopyr)*

2.25-6 qt Vastlan (2.25-6 lb ae) ($53.35-142.30)

Vastlan may be used to treat non-irrigation ditch banks, seasonally dry wetlands (including flood plains, deltas, marshes, swamps, or bogs, and transition areas between upland and lowland sites. Minimize overspray to open water when applying to banks or shorelines of moving water sites. NIS is recommended for all foliar applications. Minimum carrier is 50 gallons for ground.

Restrictions: Do not apply directly to un-impounded rivers or streams. Do not apply where runoff water may flow onto agricultural land. Do not apply in ditches or canals used to transport irrigation water or that will be used for irrigation within 4 months.

EURASIAN COMMON REED (PHRAGMITES): 2.25 qt
Apply in the early stage of growth (0.5-3 ft tall) prior to seed head development. Increased control requires another application the following year to regrowth. For backpack applications use a spray mixture of 0.75%-1.25% Vastlan.

PURPLE LOOSESTRIFE: 4.5-6 qt
Apply from bud to mid-flowering stage. Increased control requires another application the following year to regrowth.

SALTCEDAR (TAMARIX SPECIES):
Cut Stump: Apply undiluted solution to freshly cut stumps. Control may decline during periods of moisture stress. Cut stumps should be treated immediately (less than 1 hour) after cutting. Coverage is essential for root kill.

2,4-D LABEL RESTRICTIONS and NONCROP LABELING

PRODUCT: SD Registration or by Labeler	EPA Reg. #	2,4-D Acid Equiv.	Lbs. acid/gal	Non-crop	Right-of-Way	Aerial Application	Aquatic
Winfield Solutions (1387)							
Shredder Amine 4	1381-103	39.3%	3.8	Y	Y	Y	Y
Rugged	1381-247	----	3.49	Y	Y	Y	Y
Shredder E-99	1381-195	60.1%	6.0	Y	Y	Y	N
Albaugh (42750)							
AgriStar 2,4-D Amine 4	42750-19	38.9%	3.8	Y	Y	Y	Y
AgriStar 2,4-D LV 4	42750-15	42.5%	3.8	Y	Y	Y	N
AgriStar 2,4-D LV 6	42750-20	57.4%	5.5	Y	Y	Y	N
AgriStar Solve 2,4-D	42750-22	40.9%	3.76	Y	Y	Y	N
Helena Chemical Co. (5905)							
Barrage H. F. (ester)	5905-529	51.8%	4.7	Y	Y	Y	N
Opti-Amine/ Weed Rhap A-4D	5905-501	38.8%	3.8	Y	Y	Y	Y
Hardball	5905-549	19.6%	1.7	Y	Y	Y	Y
Unison	5905-542	19.6%	1.7	N	Y	N	Y
NuFarm America's & NuFarm Turf and Specialty (71368)							
Weedar 64	71368-1	38.9%	3.8	Y	Y	Y	Y
Weedone 638	71368-3	30.8%	2.8	Y	Y	Y	N
Weedone LV4 EC	228-139-71368	44.6%	3.8	Y	Y	Y	N
Weedone LV4 Solventless	71368-14	41.5%	3.8	Y	Y	Y	N
Weedone LV6 EC	71368-11	57.9%	5.5	Y	Y	Y	N
WEEDestroy AM-40 Amine Salt	228-145	39.3%	3.8	Y	Y	Y	Y
Turrent Solventless	228-95-71368	57.9%	5.5	Y	Y	N	N
PBI Gordon (2217)							
Hi-Dep Broadleaf Herbicide	2217-703	38.6%	3.8	Y	Y	Y	N
TenKoz (55467)							
Amine 4 2,4-D Herbicide	42750-19-55467	38.9%	3.8	Y	Y	Y	Y
Lo-Vol 4	42750-15-55467	42.5%	3.8	Y	Y	Y	N
Lo-Vol 6	42750-20-55467	57.5%	5.5	Y	Y	Y	N
Loveland Chemical (34704)							
Clean Amine/Amine 4 2,4-D	34704-120	38.6%	3.74	Y	Y	Y	Y
Low Vol 4 Ester	34704-124	43.4%	3.8	Y	N	Y	N
Low Vol 6 Ester	34704-125	58.9%	5.6	Y	Y	Y	N
Saber	34704-803	38.7%	3.8	Y	Y	Y	N
Salvo Low Volatile Weed Killer	34704-609	54.2%	5.0	Y	Y	N	N
Savage Dry Soluble	34704-606	78.9	DS	Y	Y	Y	Y
Van Diest Supply (11773)							
Cornbelt 4# Amine	11773-2	38.4%	3.8	Y	Y	Y	Y
Cornbelt 4# LV Ester	11773-3	43.9%	3.8	Y	Y	Y	N
Cornbelt 6# LV Ester	11773-4	58.3%	5.6	Y	Y	Y	N
Cornbelt Salvan	11773-16	54.2%	5.0	N	N	Y	N
Wilbur-Ellis (2935)							
Base Camp Amine 4	71368-1-2935	38.9%	3.8	Y	Y	Y	Y
Base Camp LV 6	2935-553	57.4%	5.5	Y	Y	N	N
Base Camp LV 6	2935-553	57.4%	5.5	Y	Y	N	N

Summary Site and Use Restrictions

Herbicide	Grazing Restrictions	Haying Restrictions	CRP	Pasture	Rangeland	Noncrop	Right-of-way	Aquatic Use	Aerial Application
2,4-D ester/amine	Lactating dairy-7 d Slaughter interval-3 d	7, 30 d[2]	Y	Y	Y	Y	Some[2]	Some[2]	Some[2]
Chaparral/Opensight *(aminopyralid+metsulfuron)*	None	None[6,7]	Y	Y	Y	Y	Y	N	Y
Cimarron Max *(metsulfuron+dicamba+2,4-D)*	Lactating dairy-7 d Slaughter interval-30 d	37 d	Y	Y	Y	N	N[10]	N	Y
Cimarron Plus *(metsulfuron+chlorsulfuron)*	None	None	Y	Y	Y	N	N[10]	N	Y
Curtail, Commando *(clopyralid+2,4-D)*	Lactating dairy-14 d Non-lactating dairy-none Slaughter interval-7 d[3]	7 d (Curtail) 30 d (Commando)	Y	Y	Y	Y	N	N	Y
Dicamba products *(dicamba)*	Lactating dairy: 1 pt/A-7 d 1-2 pt/A-21 d 1-2 qt/A-40 d Non-lactating dairy & beef-none Slaughter interval-30 d[2]	Lactating dairy: 1 pt/A-37 d 1-2 pt/A-51 d 1-2 qt/A-70 d Non-lactating dairy & beef-7 d	Y	Y	Y	Y	Some[2]	N	Some[2]
Escort *(metsulfuron)*	<1.66 oz-None >1.66 oz-3 d	<1.66 oz-None >1.66 oz-3 d	Y	Y	Y	Y	Y	N	Y
Facet/Quinstar *(quinclorac)*	None	7 d	Y	Y	Y	Y	Y	N	Y[8]
Garlon 4L *(triclopyr)*	Slaughter interval-3 d Lactating dairy-next growing season	14 d	N	N	N	Y	Y	N	Y
Glyphosate products	Spot treatment-7 or 14 d[5] Broadcast treatment-Up to 8 wk[4]	Spot treatment-7 or 14 d[5] Broadcast treatment-Up to 8 wk[4]	--	--	--	Y	Some[2]	Some[2]	Y
Rodeo *(glyphosate)*	---	---	--	--	--	Y	Y	Y	Y
Graslan/ Trooper P+D *(picloram+2,4-D amine)*	Lactating dairy-7 d Other livestock-none Slaughter interval-3 d	30 d	Y	Y	Y	Y	Y	N	Y
GrazonNext HL/ForeFront HL *(aminopyralid+2,4-D)*	None	7 d[6,7]	Y	Y	Y	Y	Y	N	Y
Habitat *(imazapyr)*	Do not graze	Do not harvest	N	N	N	Y	Y	Y	Helicopter Only
Milestone *(aminopyralid)*	None	None[6,7]	Y	Y	Y	Y	Y	N	Y
Overdrive *(dicamba+diflufenzopyr)*	None	None	Y	Y	Y	Y	Y	N	Y
Plateau/Imazapic 2SL *(imazapic)*	None	7 d	Y	Y	Y	Y	Y	N	Y
Polaris *(imazapyr)*	None[5]	7 d[5]	N	Y	Y	Y	Y	Y	Helicopter Only
Remedy Ultra *(triclopyr ester)*	None Slaughter interval-3 d	14 d	Y	Y	Y	N	N	N	Y
Stinger *(clopyralid)*	None	None	Y	Y	Y	Y[9]	N	N	N
Transline *(clopyralid)*	None	None	Y	Y	Y	Y	Y	N	Y
Telar *(chlorsulfuron)*	<1.3 oz-None	<1.3 oz-None	Y	Y	Y	Y	Y	N	Y
Tordon/Triumph/Trooper *(picloram)*	Lactating dairy-14 d Non-lactating dairy & beef-none[1] Slaughter interval-3 d[3]	<1 qt/A-none 1 qt/A or more-14 d	Y	Y	Y	Y	Y	N	Y
Vastlan *(triclopyr)*	None Slaughter interval-3 d	14 d	Y	Y	Y	Y	Y	Y	Y

1 Remove livestock to untreated grass pasture for 7 days before transferring livestock to broadleaf or broadleaf-mixed pasture areas. Otherwise, urine may contain enough product to cause injury to sensitive broadleaf plants.
2 Refer to specific label.
3 Withdrawal not needed if 2 weeks or more time elapsed since application.
4 Depending on application rate, see individual label for specific rate limits.
5 Do not treat more than 1/10 of any given acre at one time with spot or wiper applications. Remove livestock before application.
6 See supplemental label for off farm distribution/sale of hay.
7 For best weed control allow 14 days before hay harvest.
8 See label for restricted county list.
9 Fence rows, around farm buildings, and equipment pathways.
10 Right-of-ways, fencerows and farmyards adjacent to pasture, range and CRP areas.

Spot Treatment for Noxious Weeds (Spray to Wet)

Herbicide	Leafy Spurge	Canada & P. Sow Thistle	Field Bindweed	R. Knapweed Hoary Cress	Biennial Thistle	Wormwood Sage
Amount for 1 gallon…						
Tordon 22K 2L	2.5 T	2.5 T	2.5 T	2.5 T	1 t	2 t
Dicamba Product 4L	---	2.5 T	2.5 T	---	3 t	4 t
Glyphosate Product 3L	---	4 T	4 T	5 T	---	3 T
Stinger/Transline 3L	---	2 t	---	2 t	2 t	---
2,4-D 4L	4 T	3 T	3 T	4 T	3 T	3 T
Milestone	---	0.8 t	---	0.8 t	0.66 t	0.8 t
GrazonNext/ForeFront HL	---	1.4 T	---	1.4 T	1 T	1.4 T
Tordon+2,4-D	3+4 t	2+4 t	2+4 t	3+4 t	1+4 t	1+4 t
Dicamba+2,4-D	---	4+4 t	4+4 t	---	2+4 t	2+4 t
Curtail 2.38L	---	2.5 T	---	2.5 T	2 T	---
Plateau 2L	1.5 t	---	1.5 t	1.5 t	---	---
Amount for 10 gallons…						
Tordon 22K 2L	1.6 C	1.6 C	1.6 C	1.6 C	0.2 C	0.4 C
Dicamba Product 4L	---	1.6 C	1.6 C	---	0.6 C	0.8 C
Glyphosate Product 3L	---	2.5 C	2.5 C	3 C	---	1.9 C
Stinger/Transline 3L	---	0.4 C	---	0.4 C	0.4 C	---
2,4-D 4L	2.5 C	1.9 C	1.9 C	2.5 C	1.9 C	1.9 C
Milestone	---	2.8 T	---	2.8 T	2 T	2.8 T
GrazonNext/ForeFront HL	---	0.8 C	---	0.8 C	0.7 C	0.8 C
Tordon+2,4-D	0.6+0.8 C	0.4+0.8 C	0.4+0.8 C	0.6+0.8 C	0.2+0.8 C	0.2+0.8 C
Dicamba Product 4L+2,4-D	---	0.8+0.8 C	0.8+0.8 C	---	0.4+0.8 C	0.4+0.8 C
Curtail 2.38L	---	1.6 C	---	1.6 C	1.2 C	---
Plateau 2L	0.3 C	---	0.3 C	0.3 C	---	---

Select product based on labeling for the site or crop.

t = teaspoon
T = Tablespoon
C = Cup

1 tablespoon = 15 ml
1 fl oz = 2 Tablespoons
1 fl oz = 6 teaspoons
8 fl oz = 1 cup
1 fl oz = 30 ml

CHEMICAL, PHYSICAL and SAFETY CHARACTERISTICS of HERBICIDES

Properties of the most commonly used herbicides to control noxious weeds are listed in the table below. Formulation and other local conditions will affect values for most properties. Solubility is affected by formulation, temperature and soil pH.

Half-life refers to the days required for the herbicide level in the soil to be reduced to half the original amount applied. Rainfall, temperature, and soil pH are important factors affecting half-life.

Toxicity for oral ingestion and dermal exposure are expressed as the quantity required for a lethal dose for 50% of a population. The LD50 value may be multiplied by .003 to determine ounces of active ingredient that would be lethal for half a population of 180 lb subjects.

Leaching (LE) rating refers to risk of herbicide movement through the soil profile into groundwater. Chemical properties of the herbicide, soil properties and rainfall are important factors affecting leaching potential.

Herbicide movement in runoff solution (SL) is a rating for risk of movement in surface water. Rainfall amount and intensity, soil properties, surface characteristics, and herbicide rate are important variables affecting runoff solution.

Special safety equipment is based on label statements. All herbicides should be handled according to label safety guidelines using equipment and precautions that minimize risk of exposure.

Herbicide	Solubility (ppm)	Half Life (days)	Surface and Groundwater Risk		LD50 (mg/kg)	
			Leaching (LE)	Runoff Sol. (SL)	Oral	Dermal
Tordon 22K *(picloram)*	200,000	90	High	High	8200	>2000
Milestone *(aminopyralid)*	2,480	35	Low	Low	>5000	>5000
2,4-D ester	8	7	Low	Low	375	800
2,4-D amine	796,000	10	Low	Low	375	800
Banvel *(dicamba)*	400,000	14	Low to Medium	Low	1707	>2000
Stinger *(clopyralid)*	300,000	30	Moderate Potential	Low	>5000	>2000
Roundup *(glyphosate)*	400,000	47	Low	Low	4300	>940
Habitat *(imazapyr)*	11,000	90	Low	Low	>5000	>2148
Garlon *(triclopyr ester)*	23	46	Medium	Medium	630	2140
Escort/Ally *(metsulfuron)*	9500	120	Moderate@high pH	Medium	>5000	>2000
Telar *(chlorsulfuron)*	7000	160	Moderate@high pH	Medium	5545	>3400
Plateau *(imazapic)*	2232	120	Low	Low	>5000	>5000
Data base: National Water Quality Technology Staff and other references.						

BIOCONTROL of NOXIOUS WEEDS in SOUTH DAKOTA

Biocontrol offers another IPM tool for noxious weed control. The basic idea behind biocontrol is utilizing the weed's natural enemies as a means of weakening or killing the host plant. The natural enemies may include several options; however insects have been the more common choice. Insects used as biological agents for noxious weeds include: 1) seed attackers; 2) gall formers; 3) defoliators; 4) sapsuckers; 5) stem miners; 6) crown and root borers; and 7) root feeders.

Biocontrol of noxious weeds may not be the best choice in all situations. If the noxious weed infestation can be controlled by a more efficient means, such as chemical control, then that should be the option of choice. Biocontrol can work well when combined with other control tactics for an integrated approach to controlling a noxious weed. There are potential economic benefits as well as advantages where environmental situations or site restrictions limit or preclude other control options.

Biocontrol usually requires at least 3 to 5 years investment for significant results. It is important to realize that a biological control program will not eradicate noxious weeds. A residual level of the weed population is to be expected even under the best conditions.

Survival of the biocontrol agent is dependent on the density of the host noxious weeds. This is a natural cycle and should be expected so a resurgence of the weed population may occur from 1) seed bank in the soil; 2) missed plants; or 3) lagging populations of the biocontrol agent.

South Dakota continues to consider the use of new biological control agents on noxious weeds. Prior to the initial release by USDA-APHIS biocontrol agents go through a rigorous testing program to ensure they are host specific for the weed targeted. USDA-APHIS and the South Dakota Department of Agriculture are involved with the initial introductions and monitoring of the releases. These release sites are monitored for a period of time to determine that the agents will establish in the state, and will provide acceptable control of the target weed. Then the oversight responsibility for future collection and redistribution is typically passed on to the affected agencies. These may include county weed and pest boards, or state and federal land managing agencies.

Approved biological control agents are available through several reputable insectory businesses located in neighboring states. Prices and availability for specific biocontrol agents may vary from year to year. Many of the biological control agents released in South Dakota may be available for collection and redistribution at no cost. Please contact your county weed and pest control board for more information.

Common noxious weed biocontrol options in South Dakota:

Leafy spurge: Several insects were evaluated as a potential biocontrol agent in South Dakota. Of these, the leafy spurge flea beetle became the agent of choice over time. Of the flea beetle group, the black leaf beetles *(Aphthona lacertosa and Aphthona czwalinae)* and the brown flea beetle *(Aphthona nigriscutis)* have shown the best results. This insect is quite adaptable to much of the state's diverse climate and environmental conditions. Flea beetles are sun-loving insects that prefer day sites; however A. lacertosa can tolerate cooler, shadier, and wetter sites.

Another approved bioagent for leafy spurge that shows limited success is a stem boring larvae *(Oberea erythrocephala)*. This insect feeds on the leafy spurge leaves, bracts, and girdles the stems.

Currently, the South Dakota Department of Agriculture coordinates the redistribution program for the leafy spurge flea beetles. The county weed and pest boards is the local contact point for landowners or land managers considering the use of flea beetles in the leafy spurge management program. South Dakota landowners can collect the flea beetles, free of charge, at state supervised collection days in mid to late June. Many county weed and pest programs also have their own organized flea beetle collections as well.

Musk thistle: The musk thistle seed head weevil *(Rhinocyllus conicus)* was the first major biocontrol program for noxious weeds in South Dakota. Introductions were made in the late 1970's to early 1980's. Currently this seed weevil can be found throughout the state in musk thistle infestations as well as the native thistle. Further releases are not recommended. A rosette weevil *(Trichosirocalus horridus)* has been released in some counties of the state and has shown some success.

Canada thistle: Two insect biocontrol agents currently being used in the state include a stem mining weevil *(Hadroplatus litura)* and a thistle stem gall fly *(Urophora cardui)*. Damage from the developing stem mining weevil larvae to the plant comes from the mining of the thistle stem as the shoot elongates. The thistle stem gall fly adult lays eggs and when they hatch the developing larvae stimulate the plant to form a hard woody stem gall.

The gall directs the nutrients away from the plant's metabolic and reproductive functions thus affecting seed production.

Purple loosestrife: A leaf feeding beetle *(Galerucella calmariensis and Galerucella pusilla)* has been introduced in wetland sites invaded by this noxious weed. The Galerucella species has been used in South Dakota and Nebraska in a special project coordinated by these two states. An insectory was developed to rear this biocontrol agent for use in this special project and has yielded thousands of insects that have led to the decline of purple loosestrife in the release areas. A root boring insect, *Hylobus transversovittatus*, has also been released. Larvae feed on the root hairs and mine into roots and crown affecting the plant's ability to move nutrients and water throughout the plant.

Spotted knapweed: The primary bioagent released for the control of spotted knapweed is the knapweed flower head weevil *(Larinus minutus)*. A root boring weevil *(Cyphocleonus achates)* has also been released and an insectory is being set up by the South Dakota Department of Agriculture to rear this insect for distribution through a special weed management project involving South Dakota and Nebraska.

Dalmatian toadflax: A stem boring weevil *(Mecinus janthinus)* has been a successful option for controlling Dalmatian toadflax. Adult weevils feed externally on the foliage and the larvae feed on the plants vascular tissue reducing or eliminating flower and seed production.

LEAFY SPURGE BIOAGENTS

Fig. 1 *Aphthona nigriscutis* adult (brown flea beetle)

Fig. 2 *Aphthona lacertosa* (black flea beetle)

Fig. 3 *Aphthona lacertosa* beetles on leafy spurge

Fig. 4 SD flea beetle collection/beetle trap

Fig. 5 *Oberea erythrocephala* on leafy spurge

CANADA THISTLE BIOAGENTS

Fig. 6 *Hadroplantus litura* (Canada thistle stem mining weevil)

Fig. 7 *Hadroplantus litura* larvae and damage to Canada thistle stems

Fig. 8 *Urophora cardui* (Canada thistle gall fly and gall on Canada thistle stem)

MUSK THISTLE BIOAGENTS

Fig. 9 *Rhinocyllus Conicus* adult (musk thistle seed weevil)

Fig. 10 Left: Normal musk thistle seed head. Right: infested seed head.

Fig. 11 *Trichosivocalus horridus* adult (musk thistle Rosette weevil)

DALMATIAN TOADFLAX BIOAGENTS

Fig. 12 Stem boring weevil (*Mecinus Janthinus*) on Dalmatian toadflax

SPOTTED KNAPWEED BIOAGENTS

Fig. 13 *Larinus minutus* adult (flower-head weevil) and emergence hole in a knapweed seed head.

PURPLE LOOSESTRIFE BIOAGENTS

Fig. 14 *Galerucella sp.* defoliating beetle and rearing buckets and tents

Photo credits: USDA/ARS (Figs. 1, 2, 5, 6, 7, 8, and 11), Eric Coombs (Fig. 13).

P-00144

Section VIII
Maps

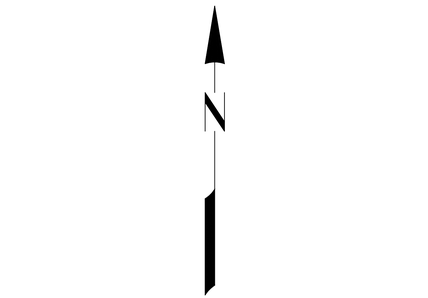
Loring Quarry

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Plan View

Prepared 8-9-2021
Prepared by: Nathan Oliver



Scale: 1"=250'
Contours: 5 ft

- SECTION LINE
- PROPOSED LORING QUARRY MINE PERMIT BOUNDARY
- SD HWY 89
- QUARRY ACCESS ROAD
- STRUCTURES
- MICKELSON TRAIL
- DRAINAGE
- PROPOSED PERMITTED AFFECTED AREA
- OVERHEAD ELECTRICAL
- TOPSOIL STOCKPILES
- OVERBURDEN STOCKPILES
- A — A' PROFILE CENTERLINE "A"
- B — B' PROFILE CENTERLINE "B"
- C — C' PROFILE CENTERLINE "C"
- D — D' PROFILE CENTERLINE "D"

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SDCL 45-6B-10(1)
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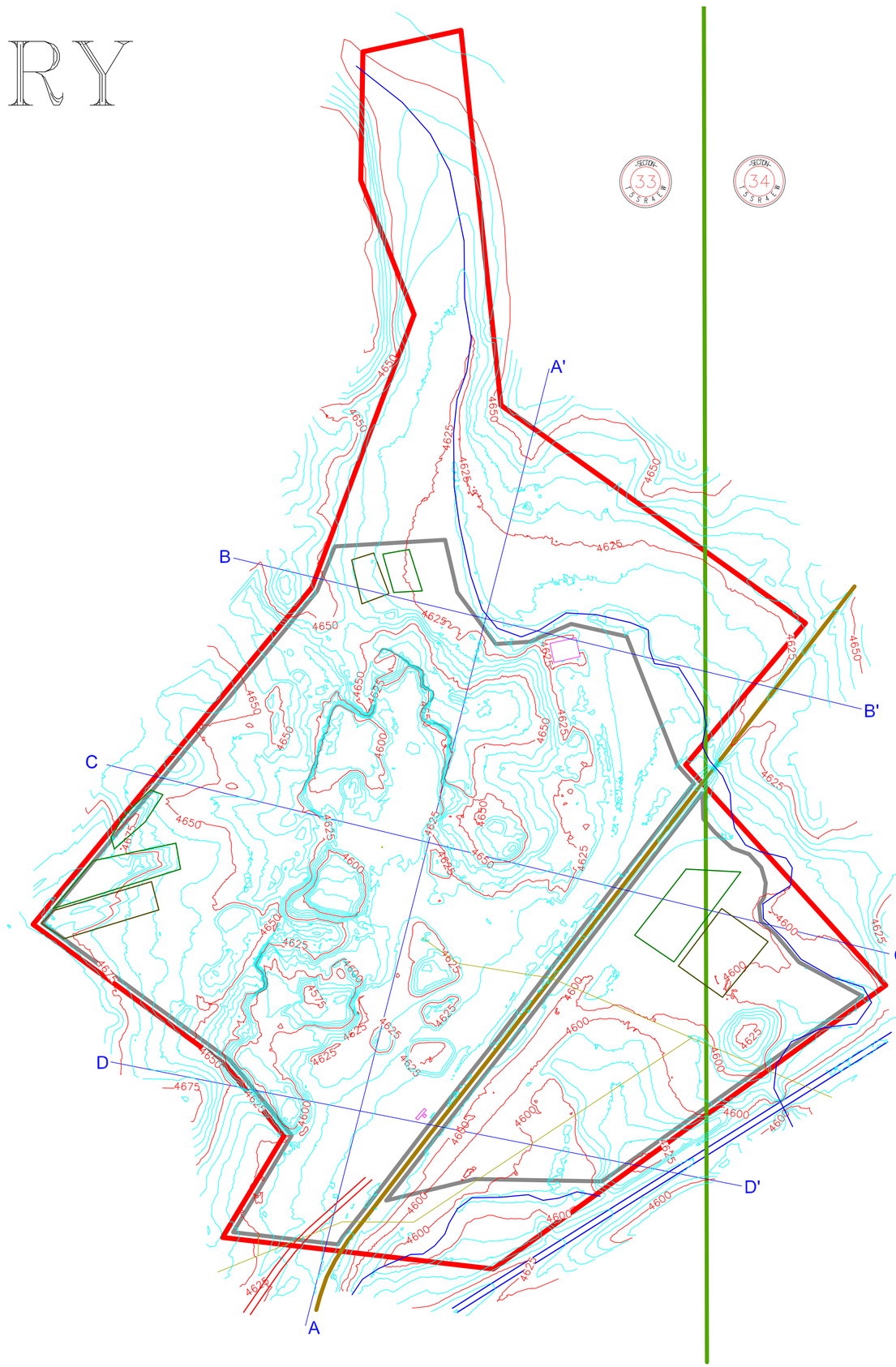

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile A-A'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=125'

125 0 63 125 250 500

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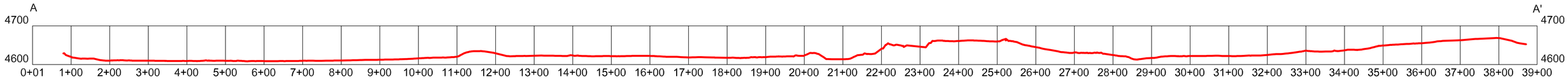
SDCL 45-6B-6(8)(b)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile B-B'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

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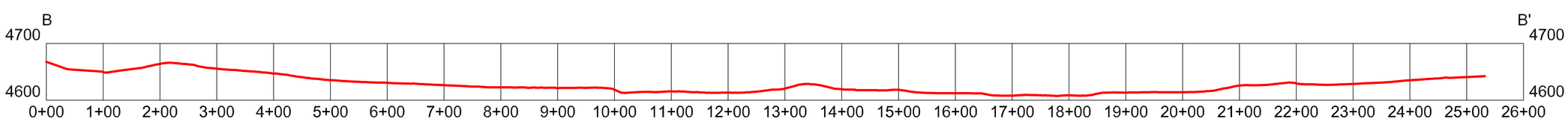

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile C-C'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=125'

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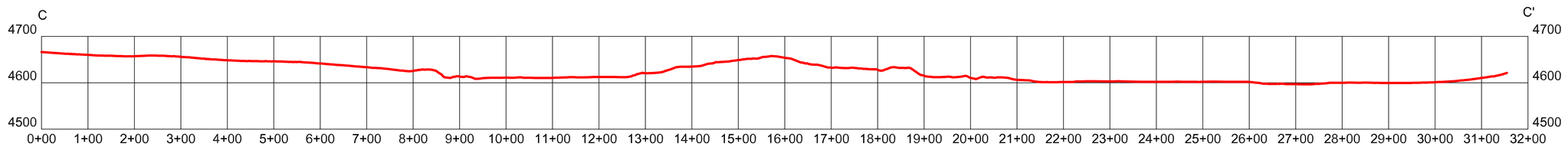

LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pre-mining Contour Profile D-D'

Prepared 8-9-2021
Prepared by: Nathan Oliver

Scale: 1"=100'

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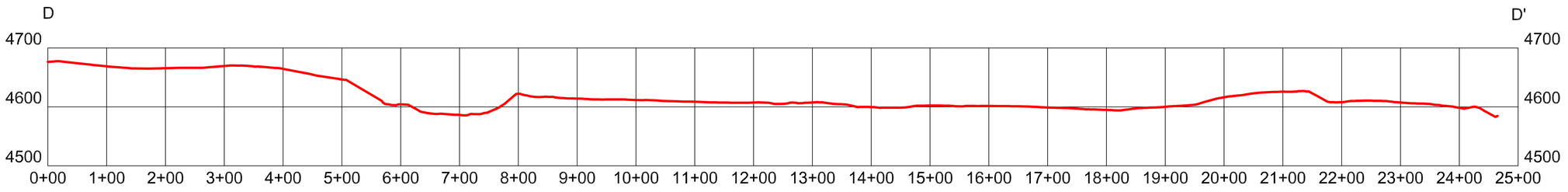
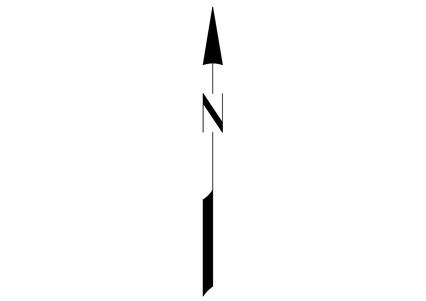


LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Pit Final Contour Plan View

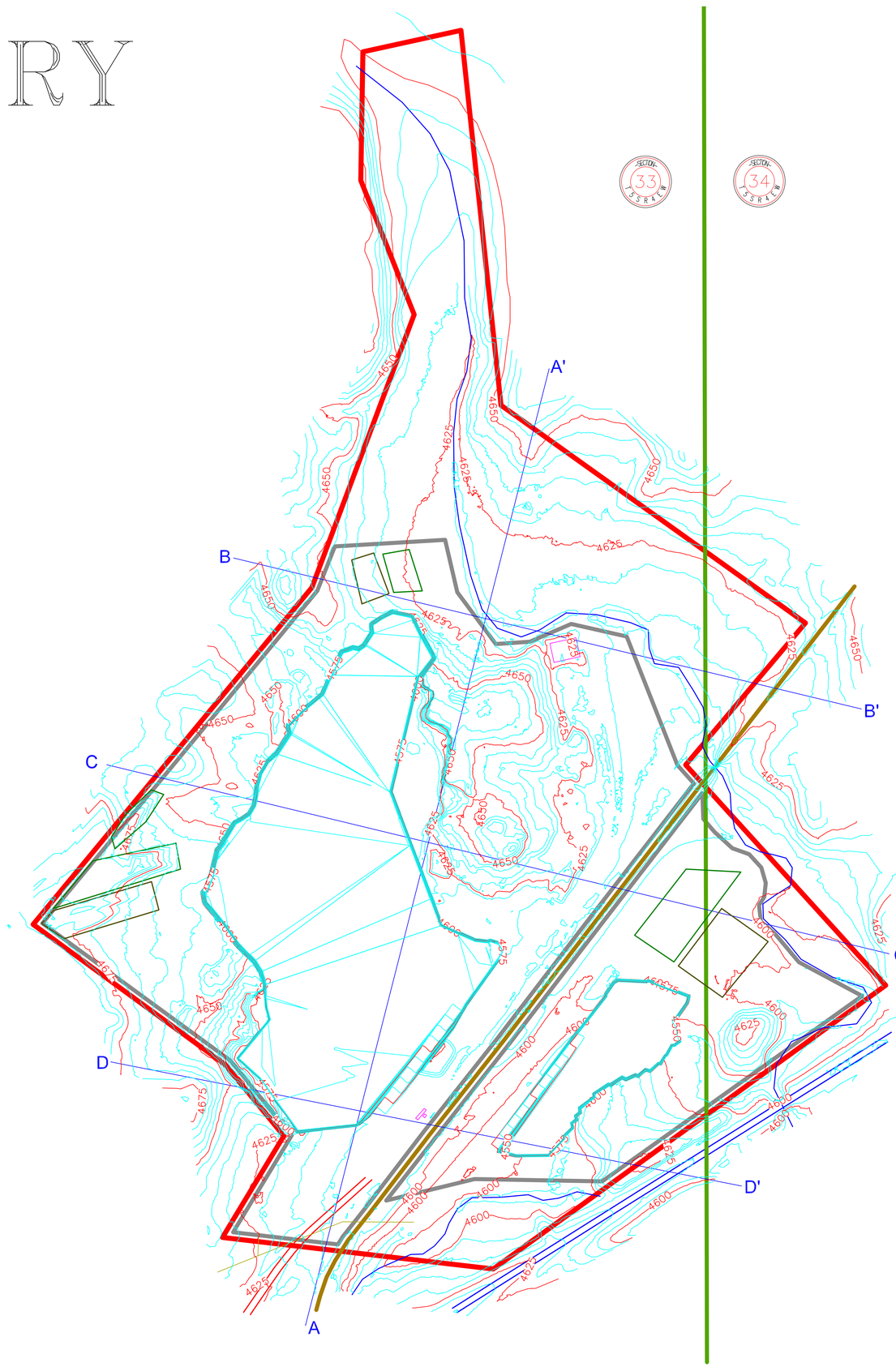
Prepared 4-9-2022
Prepared by: Nathan Oliver



Scale: 1"=250'
Contours: 5 ft

- SECTION LINE
- PROPOSED LORING QUARRY MINE PERMIT BOUNDARY
- SD HWY 89
- QUARRY ACCESS ROAD
- STRUCTURES
- MICKELSON TRAIL
- DRAINAGE
- PROPOSED PERMITTED AFFECTED AREA
- OVERHEAD ELECTRICAL
- TOPSOIL STOCKPILES
- OVERBURDEN STOCKPILES
- A — A' PROFILE CENTERLINE "A"
- B — B' PROFILE CENTERLINE "B"
- C — C' PROFILE CENTERLINE "C"
- D — D' PROFILE CENTERLINE "D"

ARSD 74:29:02:04(2)
SDCL 45-6B-6(8)(a)



LORING QUARRY

Sections 33 & 34; T5S–R4E
Custer County, SD

Simon Contractors
Post–mining Contour Plan View

Prepared 8–17–2021
Prepared by: Nathan Oliver

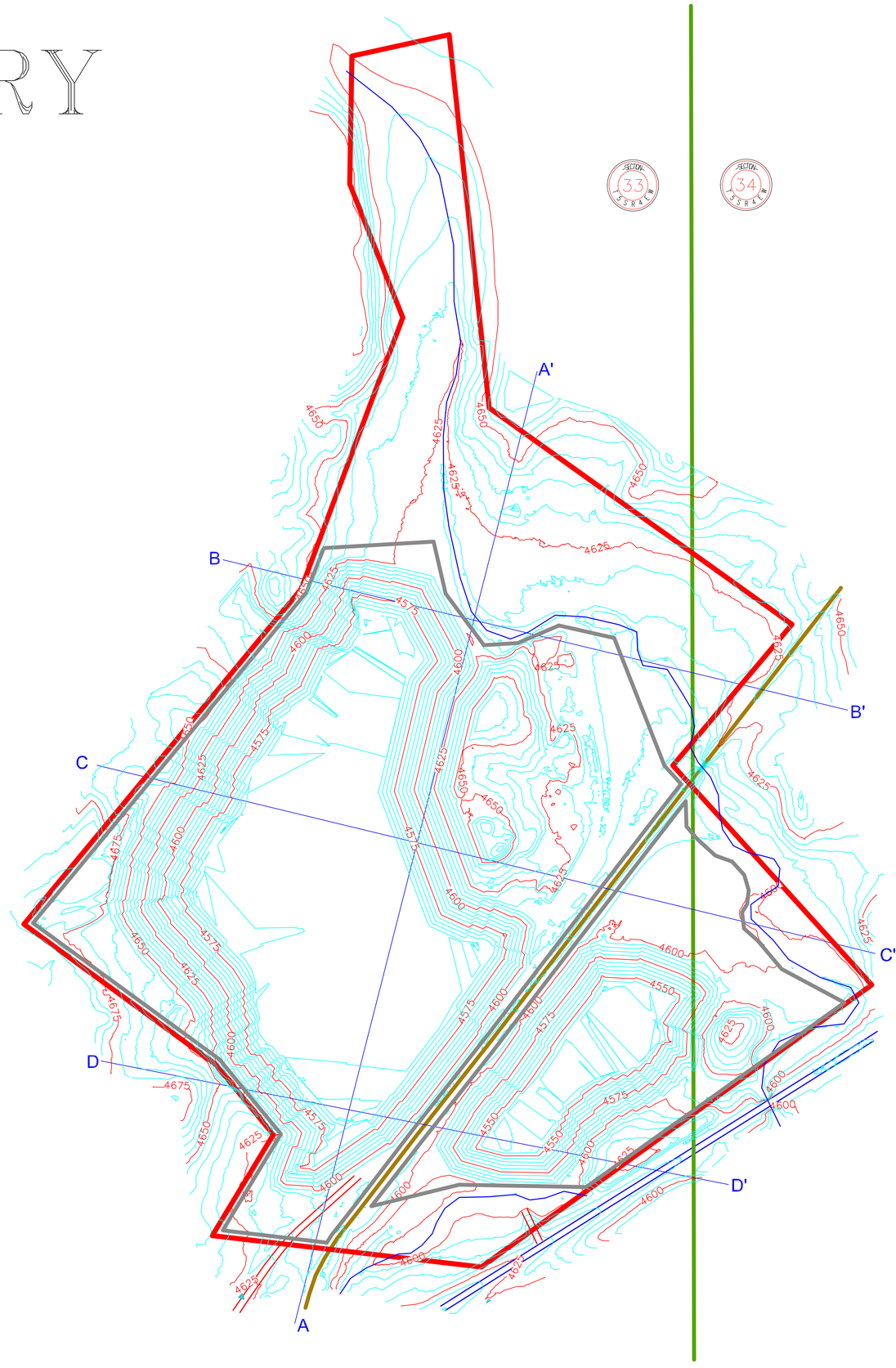
N

250 0 125 250 500 1000

Scale: 1”=250’
Contours: 5 ft

- SECTION LINE
- PROPOSED LORING QUARRY MINE PERMIT BOUNDARY
- SD HWY 89
- QUARRY ACCESS ROAD
- MICKELSON TRAIL
- DRAINAGE
- PROPOSED PERMITTED AFFECTED AREA
- A — A' PROFILE CENTERLINE "A"
- B — B' PROFILE CENTERLINE "B"
- C — C' PROFILE CENTERLINE "C"
- D — D' PROFILE CENTERLINE "D"

ARSD 74:29:02:04(2)
SDCL 45-6B-6(8)(a)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Final Pit vs Reclamation Contour Profile A-A'

Prepared 4-9-2022
Prepared by: Nathan Oliver

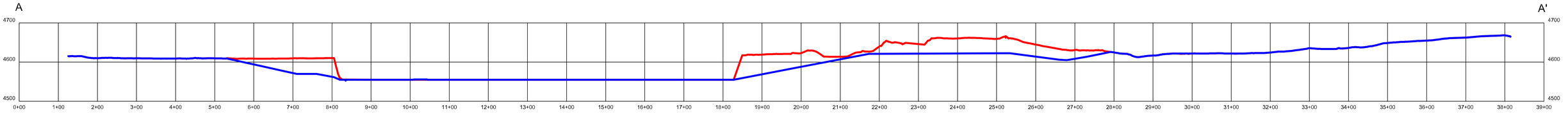
Scale: 1"=125'

125 0 63 125 250 500

Final Pit Profile

Final Reclamation Profile

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Final Pit vs Reclamation Contour Profile B-B'

Prepared 4-9-2022
Prepared by: Nathan Oliver

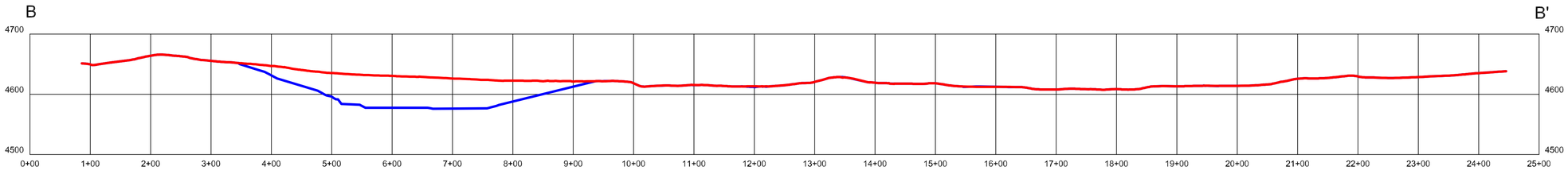
Scale: 1"=100'

100 0 50 100 200 400

Final Pit Profile

Final Reclamation Profile

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Final Pit vs Reclamation Contour Profile C-C'

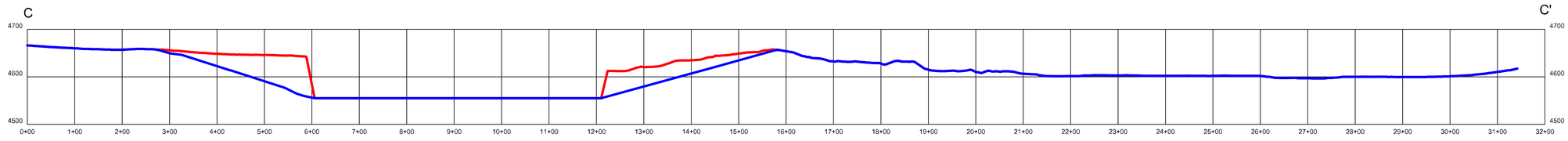
Prepared 4-9-2022
Prepared by: Nathan Oliver

Scale: 1"=125'

Final Pit Profile

Final Reclamation Profile

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)



LORING QUARRY

Sections 33 & 34; T5S-R4E
Custer County, SD

Simon Contractors
Final Pit vs Reclamation Contour Profile D-D'

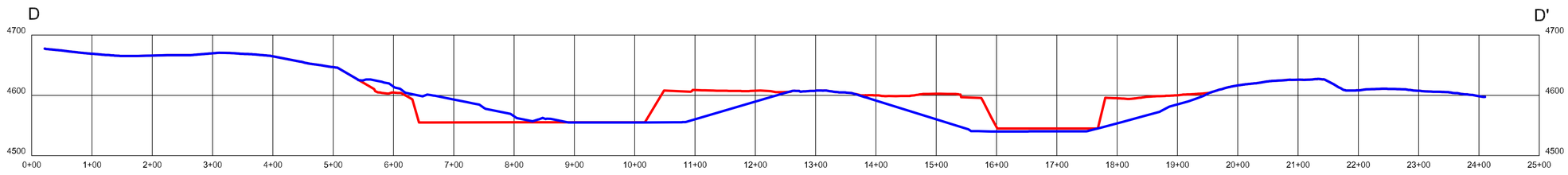
Prepared 4-9-2022
Prepared by: Nathan Oliver

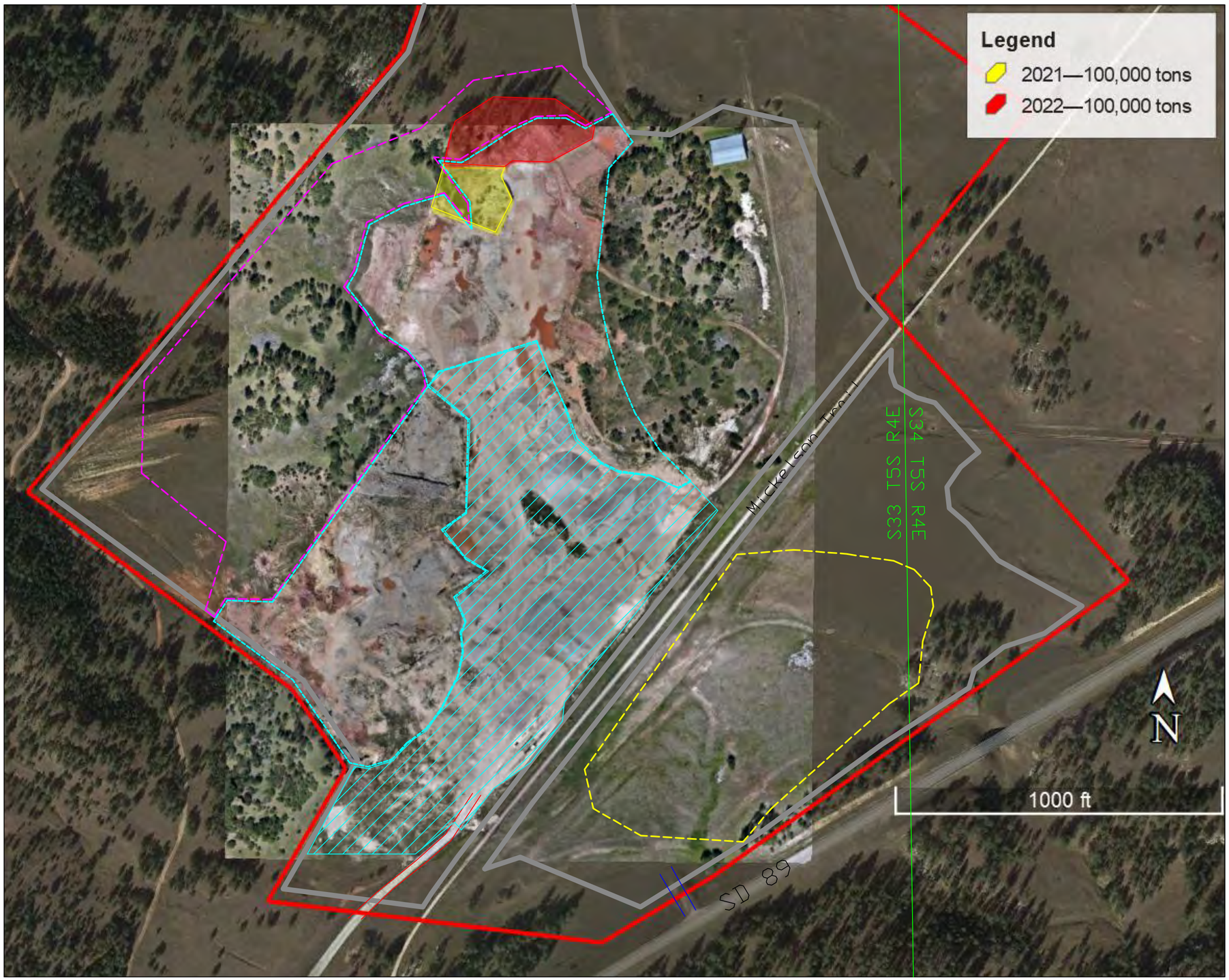
Scale: 1"=100'

Final Pit Profile

Final Reclamation Profile

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)





Simon Contractors

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

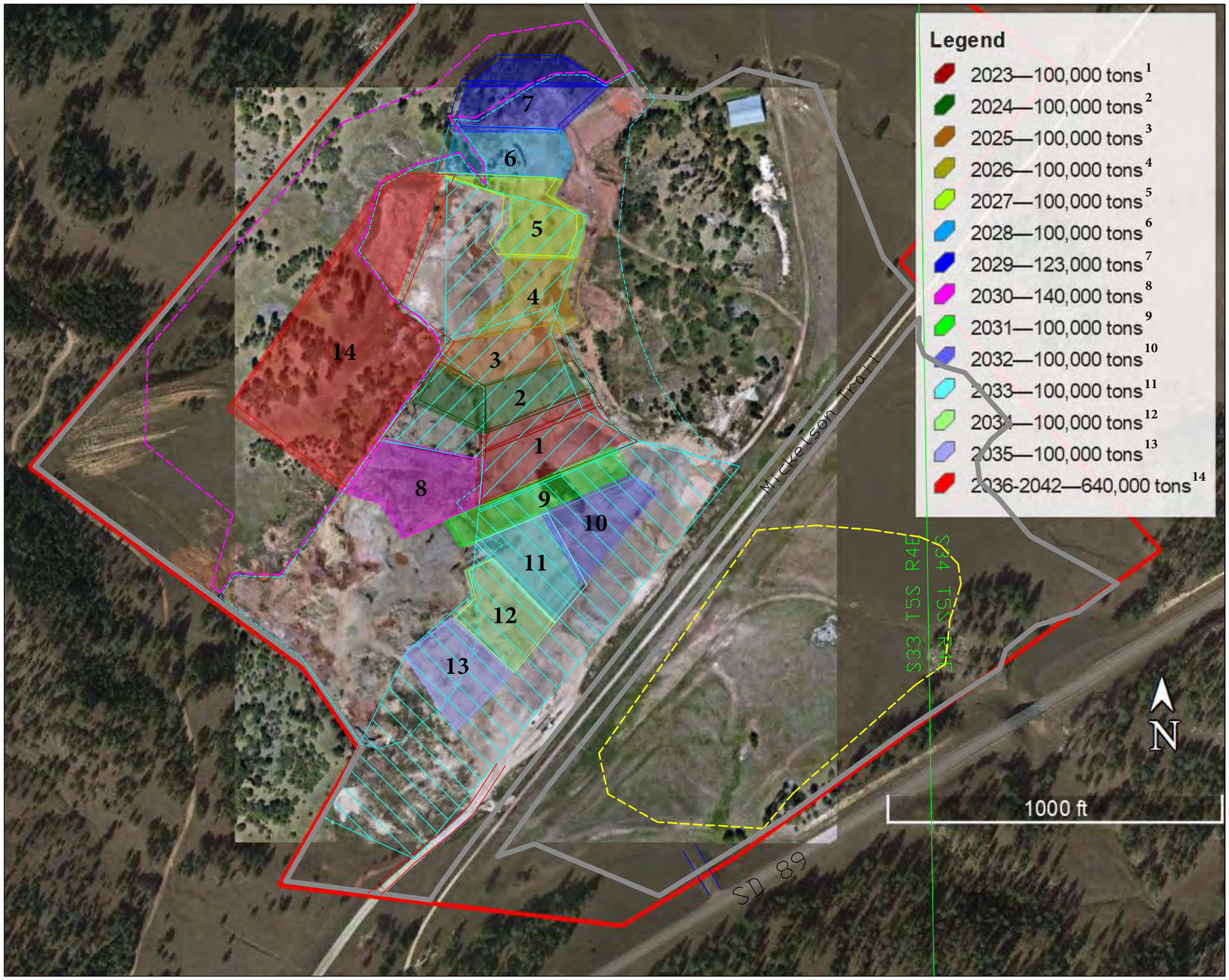
- Proposed Loring Quarry Mine Permit Boundary
- Current Stockpile Area
- Section Boundary
- Proposed Permitted Affected Area
- On-Property Access Road
- DOT Access
- Current Limestone Quarry
- Western Quarry Expansion
- Eastern Quarry Expansion

N
S

0 500 1000

Loring Quarry Mine Sequence 2021-2022

Drawn by Nathan Oliver
4/7/2021



Simon Contractors

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

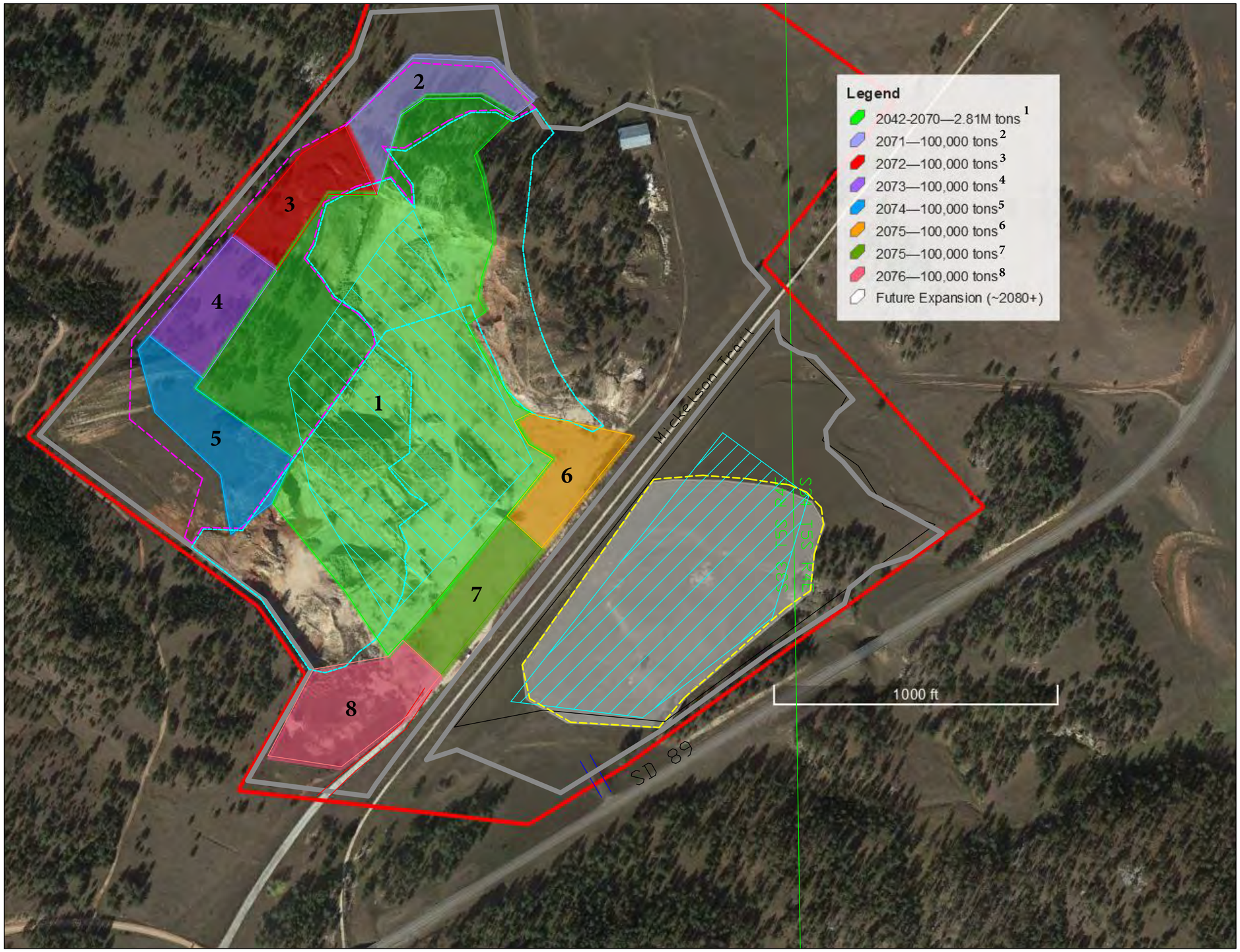
- Proposed Loring Quarry Mine Permit Boundary
- Section Boundary
- Stockpile Area, 2023-2026
- Stockpile Area, 2026-2042
- Proposed Permitted Affected Area
- On-Property Access Road
- DOT Access
- Current Limestone Quarry
- Western Quarry Expansion
- Eastern Quarry Expansion

N
S

0 500 1000

Loring Quarry Mine Sequence 2023-2042

Drawn by Nathan Oliver
4/7/2021



Simon Contractors

ARSD 74:29:02:04(3)
SDCL 45-6B-6(8)(b)

- Proposed Loring Quarry Mine Permit Boundary
- Section Boundary
- Stockpile Area, 2042-2085
- Stockpile Area, 2085+
- Proposed Permitted Affected Area
- On-Property Access Road
- DOT Access
- Current Limestone Quarry
- Western Quarry Expansion
- Eastern Quarry Expansion

N

S

0 500 1000

Loring Quarry Mine Sequence ~2042-2085+

Drawn by Nathan Oliver
4/7/2021

SIMON

Loring Quarry
Previously Mined Land
SDCL 45-6B-8

0 480 960 1,920

Feet

N W E S

Scale: 1:7,000

Date Produced: 2/21/2022

Designed to be printed at 11" x 17"

Prepared by:

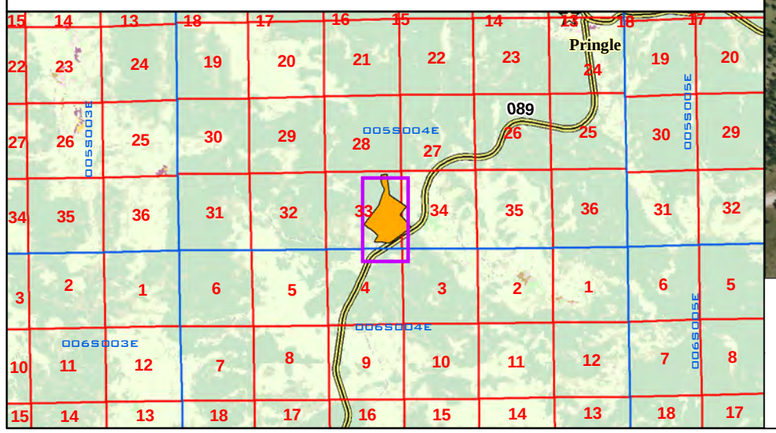
Editor: RGilson

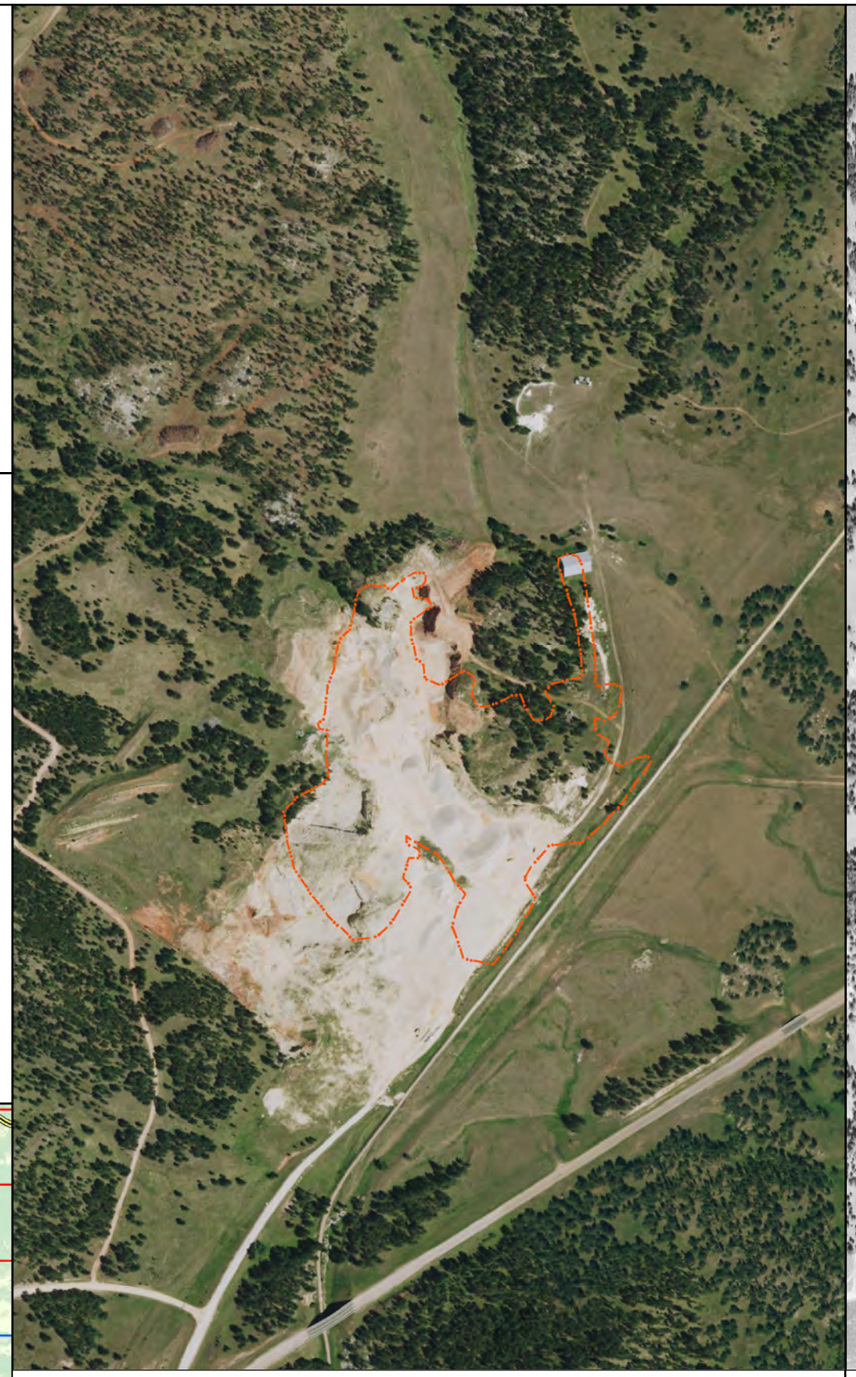
Previously Mined Land Extents 1953 (Approx. Boundary)

Estimated surface disturbance in 1953 = 25.02 Acres

Note: The previously mined land extent boundary and area are estimate based on the georeferenced photo from 1953.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Above Image:
NAIP Imagery Dated 2020
Downloaded from USDA Geospatial Data Gateway - Direct Data/NAIP Download - Nationla Ag. Imagery Program County Mosaic (https://gdg.sc.egov.usda.gov/GDGHome_DirectDownLoad.aspx)
ID: ortho_1-1_hn_s_sd033_2020_1

Above Image:
Aerial Photo Single Frame Dated 9/26/1953
Downloaded from USGS EarthExplorer (https://earthexplorer.usgs.gov/)
Entity ID: AR1VBM000010087
Image was georeferenced using identifiable landscape features and historic structures.

SIMON

Loring Quarry
Mine Plan Map
SDCL 45-6B-10

0 410 820 1,640

Feet

N W E S

Scale: 1:6,000

Date Produced: 4/18/2022

Designed to be printed at 11" x 17"

Prepared by:

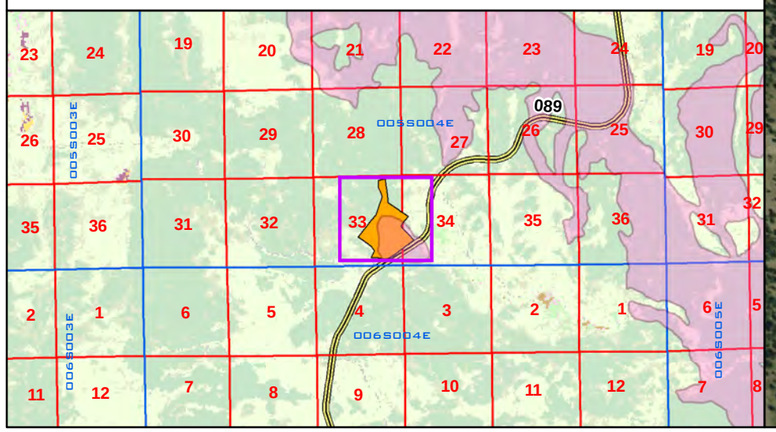
Editor: RGilson

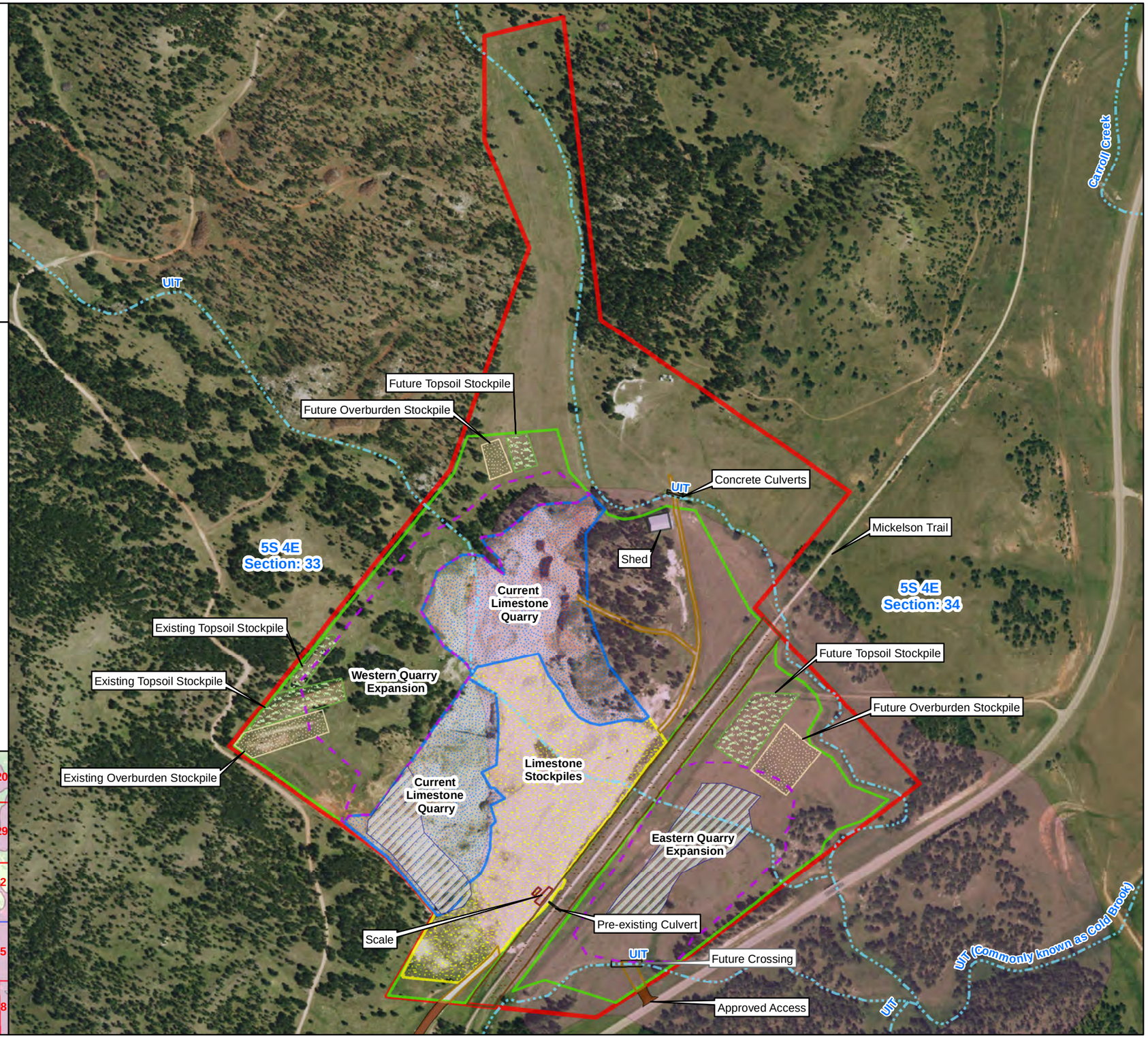
- Drainages
- Proposed Mine Permit Boundary
- Culvert
- Building
- Scale
- Topsoil Stockpile
- Overburden Stockpile
- Current Limestone Stockpile Area
- Current Limestone Quarry
- Quarry Expansion Area
- Proposed Permitted Affected Area
- On Property Road
- Anticipated Overburden Application Area
- Madison Limestone
- Mickelson Trail 50' Buffer
- Off Property Access Road

UIT = Unnamed Intermittent Tributary

Notes: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land. Base map is an NAIP 2020 Aerial Image. Overlaying Surficial Deposits (Madison Limestone) are from publication: Overlying surficial deposits and absent areas for the Madison Limestone, Black Hills area, South Dakota, Version 1.0, April 12, 2000, https://water.usgs.gov/lookup/getspatial?ofr00471_mdsnsurf

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Plan_Map_v5

SIMON

Loring Quarry
Water Resources
ARSD 74:29:02:11(3)(4)

0 0.1 0.2 0.4

Miles

N W E S

Scale: 1:8,000

Date Produced: 4/14/2022

Designed to be printed at 11" x 17"

Prepared by:

Editor: RGilson

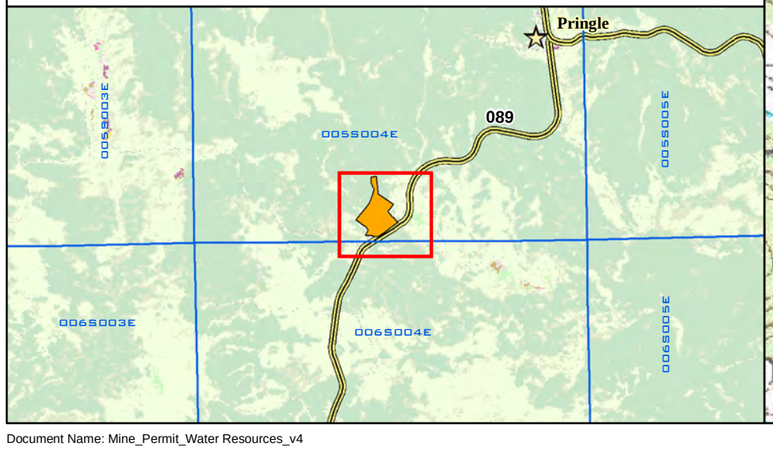
- Spring
- Domestic
- Stock
- Drainages
- Vegetated Swale
- Mickelson Trail
- SD Highways
- Permit Boundary 200ft Buffer
- Proposed Mine Permit Boundary
- Culvert
- Current Limestone Stockpile Area
- Current Limestone Quarry
- Quarry Expansion Area
- Proposed Permitted Affected Area
- On Property Road

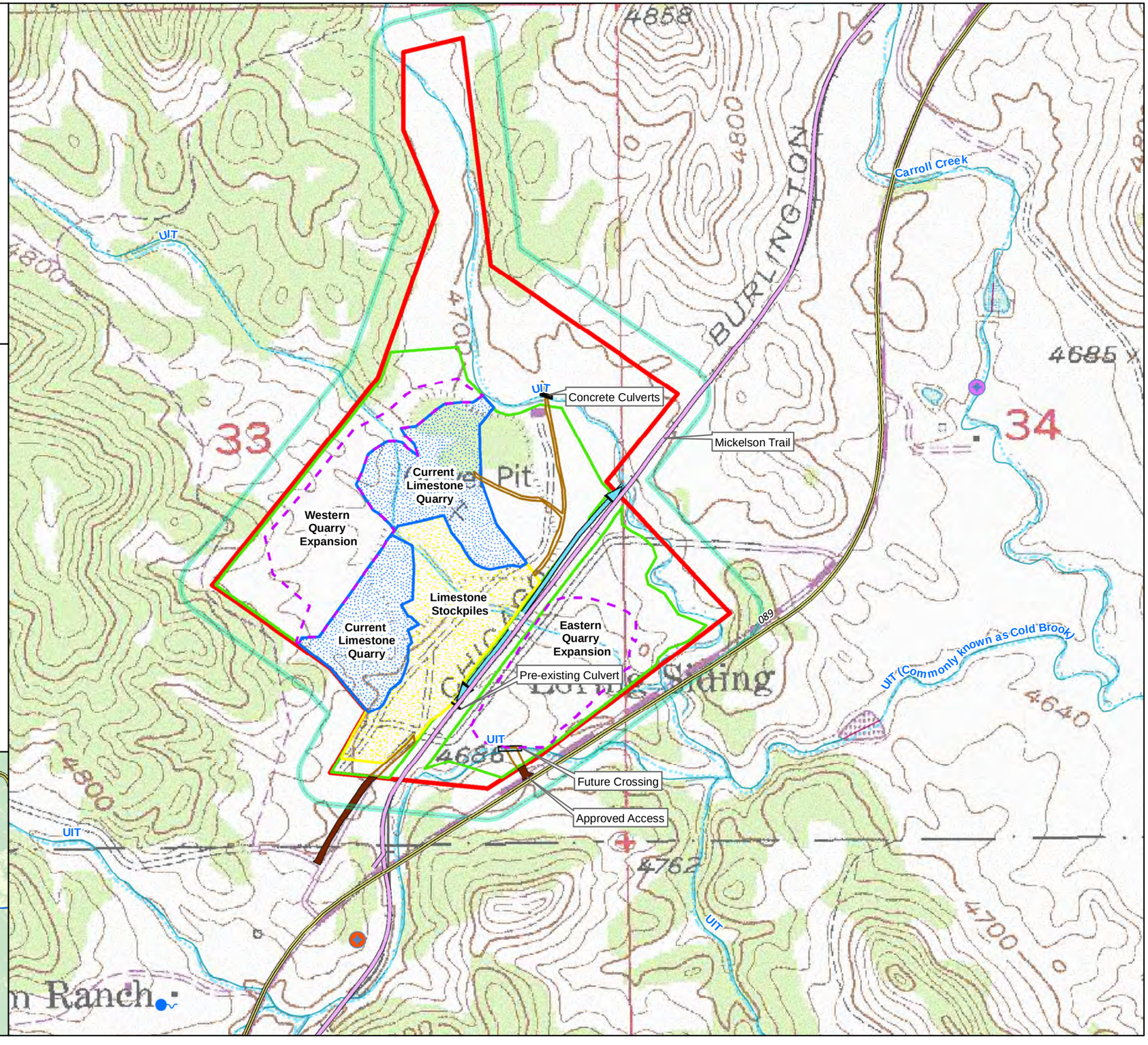
UIT = Unnamed Intermittent Tributary

Note: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land.

Note: Base map is a U.S. geological survey seven-and-one-half-minute quadrangle map in accordance with ARSD 74:29:02:12.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Permit_Water Resources_v4

SIMON

Loring Quarry
Water Resources
ARSD 74:29:02:11(3)(4)

0 0.25 0.5 1

Miles

N W E S

Scale: 1:20,000

Date Produced: 4/14/2022

Designed to be printed at 11" x 17"

Prepared by:

Editor: RGilson

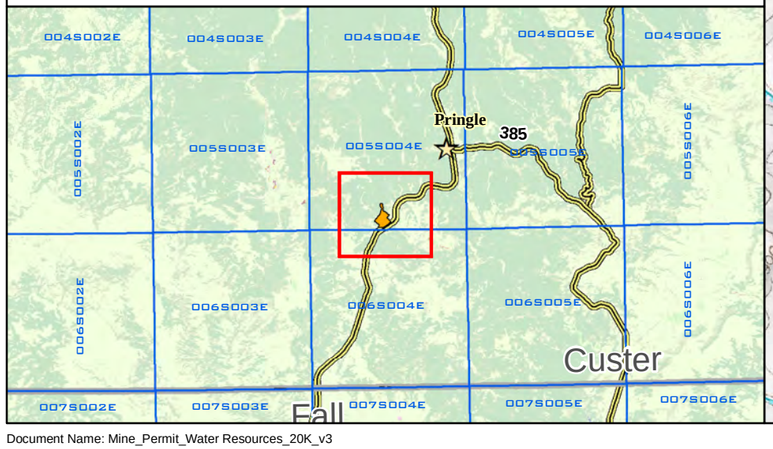
- Spring
- Domestic
- Stock
- Drainages
- Vegetated Swale
- Mickelson Trail
- SD Highways
- Permit Boundary 200ft Buffer
- Proposed Mine Permit Boundary
- Culvert
- Current Limestone Stockpile Area
- Current Limestone Quarry
- Quarry Expansion Area
- Proposed Permitted Affected Area
- On Property Road

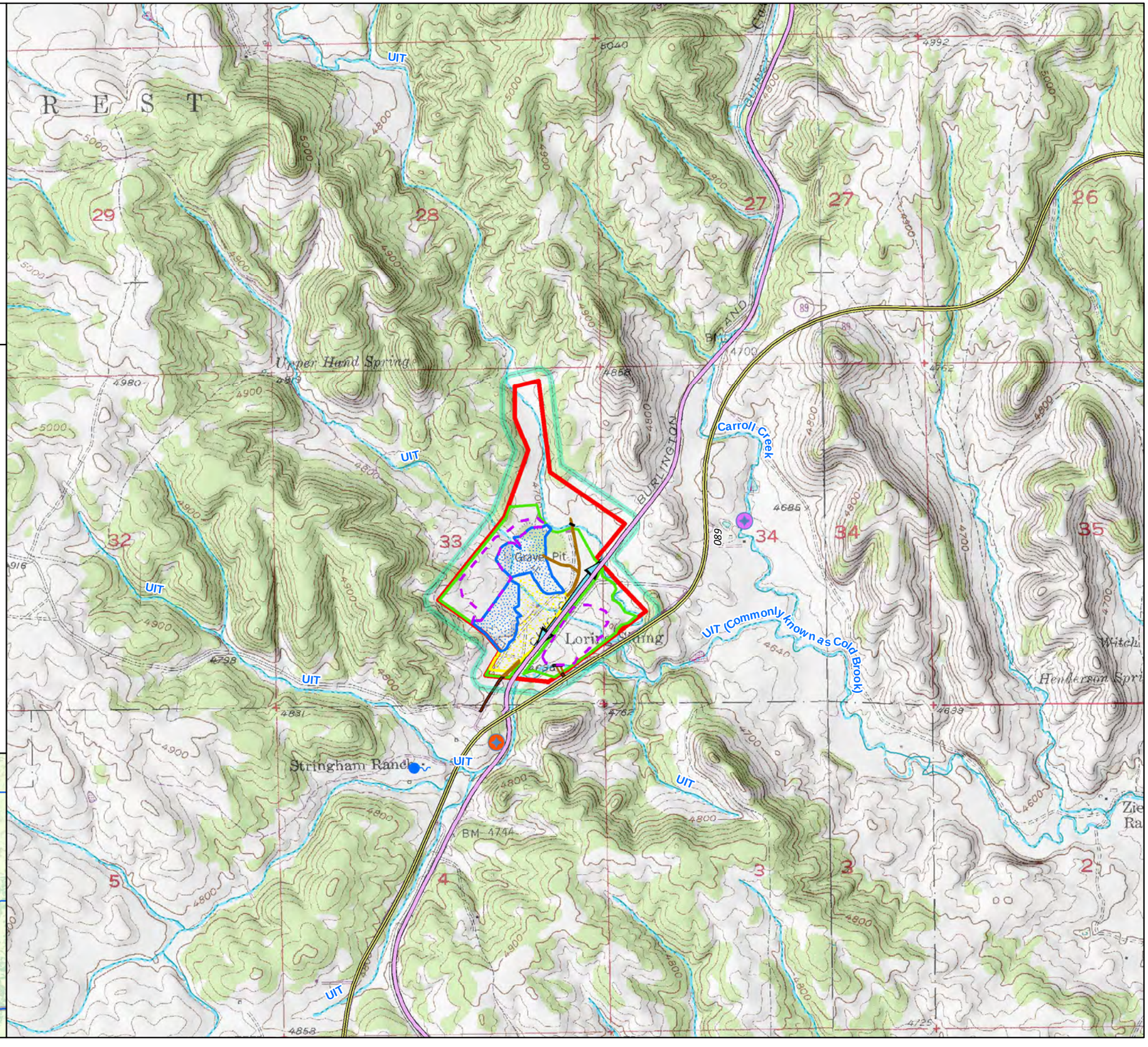
UIT = Unnamed Intermittent Tributary

Note: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land.

Note: Base map is a U.S. geological survey seven-and-one-half-minute quadrangle map in accordance with ARSD 74:29:02:12.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Permit_Water Resources_20K_v3

SIMON

Loring Quarry
USGS Geologic Map

0 0.3 0.6 1.2

Miles

N W E S

Scale: 1:28,500

Date Produced: 4/14/2022

Designed to be printed at 11" x 17"

Prepared by:

Editor: RGilson

Qal — **Alluvial deposits (Holocene and Pleistocene)**—Stream-laid deposits of mud, silt, sand, and gravel. Narrow deposits not shown. Maximum thickness 10 m

PPm — **Minnelusa Formation (Lower Permian and Pennsylvanian), undivided**—Sandstone, limestone, and minor shale. Thickness 120 to about 350 m

Mp — **Pahasapa Limestone (Lower Mississippian)**—Mainly thick-bedded dolomitic limestone. Reef-like, bluish limestone in uppermost part. Includes Englewood Limestone (unit MDe) in areas of steep terrain. Thickness 80–210 m

Tw — **White River Group (Oligocene and Upper Eocene)**—Silty claystone and poorly indurated sandstone, arkose, and conglomerate. Gravel at higher elevations. Thickness as much as 120 m

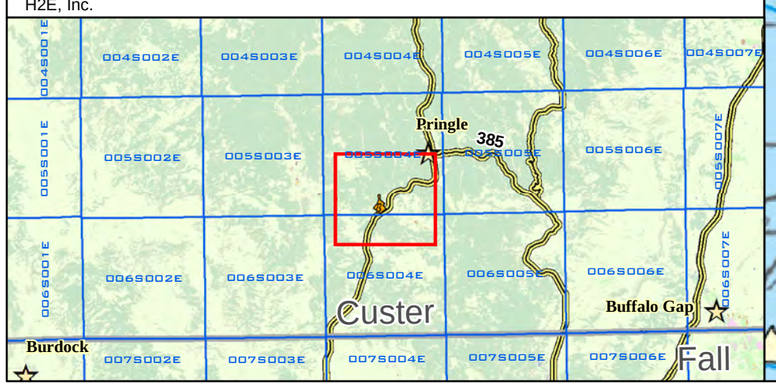
Dome—Size of symbol arbitrary for most domes. Asymmetry indicated by length of arrow for the Lead dome (51) and the Brownsville dome (56). Dashed where approximately located; dotted where concealed

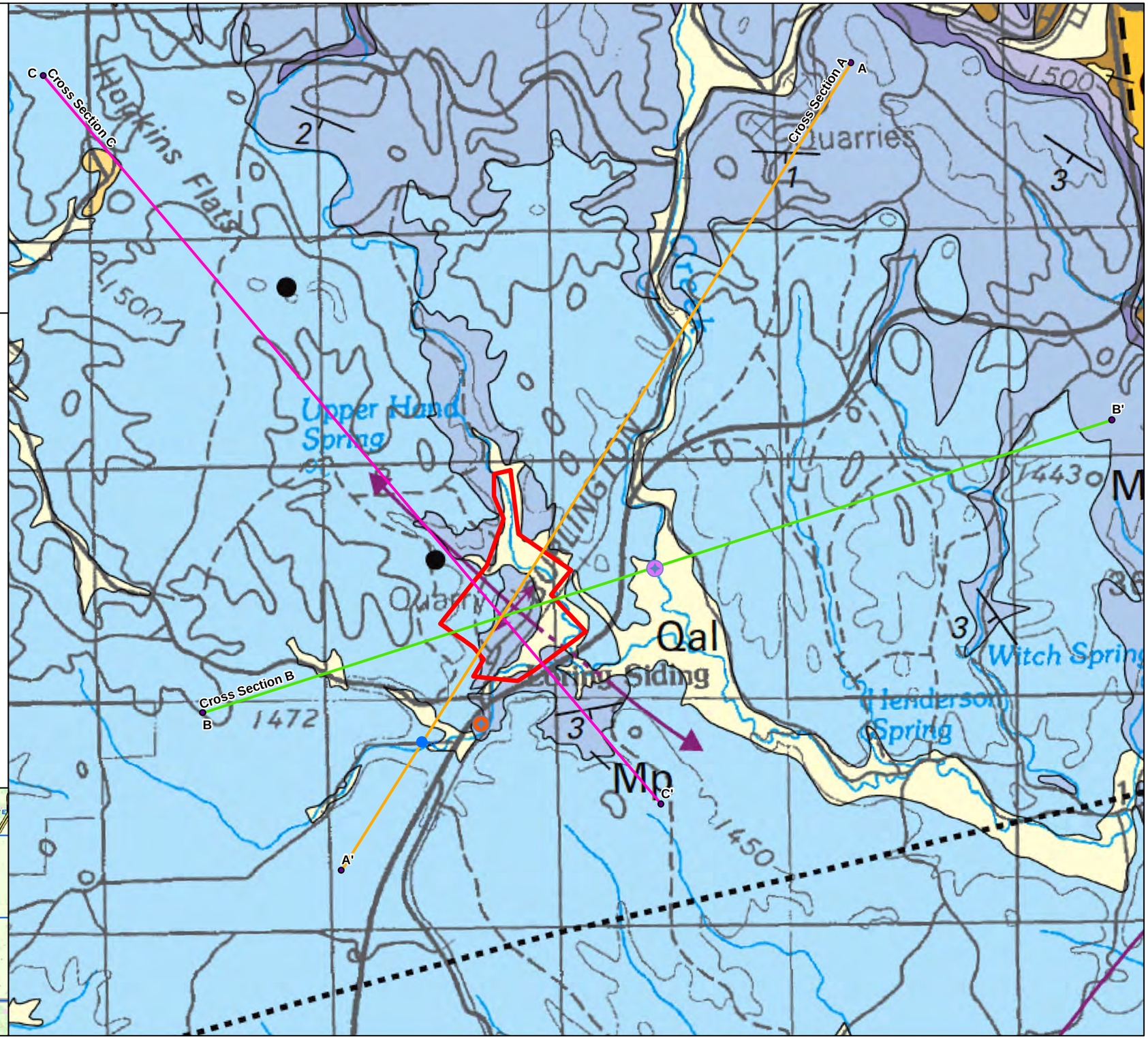
Spring — Stock — Cross Section B

Domestic — Cross Section A — Cross Section C

Data Extracted from:
Jack A. Redden and Ed DeWitt, 2008, USGS Maps Showing Geology, Structure, and Geophysics of the Central Black Hills, South Dakota, Scientific Investigations Map 2777, Sheet 1 of 2.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Permit_Geologic_v3

SIMON

Loring Quarry
Geological Cross Sections
ARSD 74:29:02:11(2)

Alluvial Deposits

Minnelusa Formation

White River Group

Pahaspa Limestone

Assumed direction of groundwater flow in Madison aquifer.

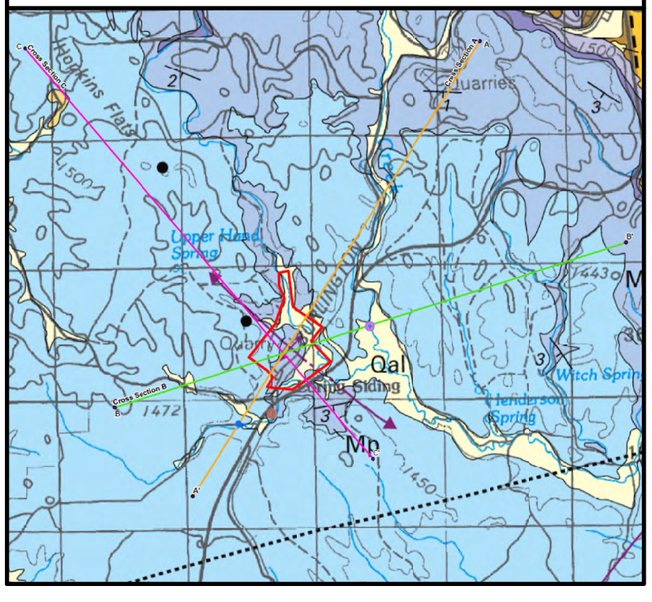
Assumed local direction of groundwater flow in Minnelusa aquifer.

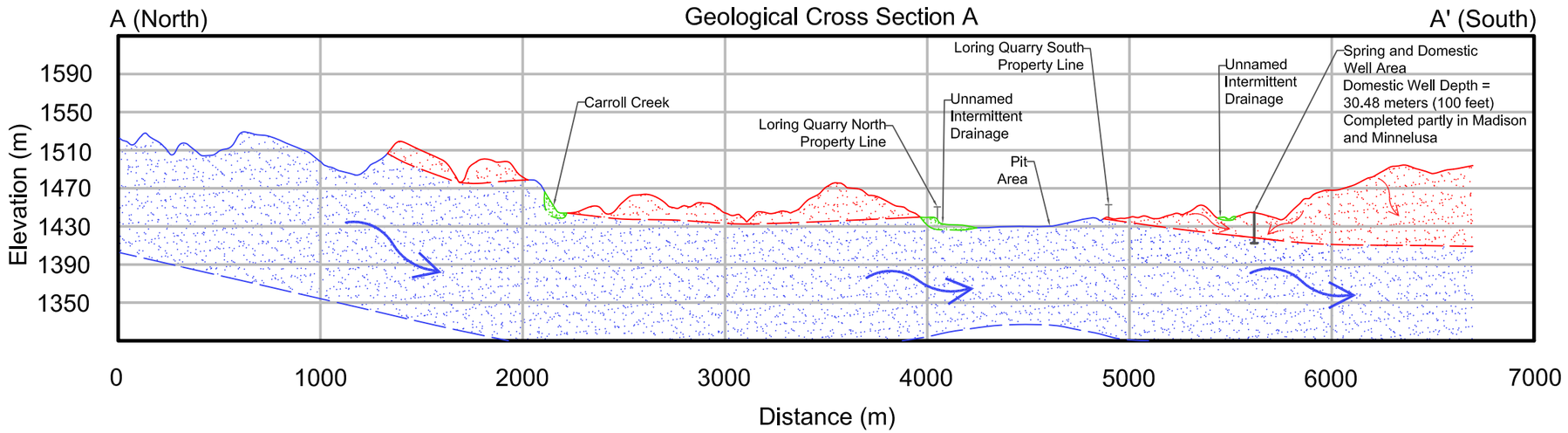
Vertical Exaggeration 5.2:1 for each cross-section.

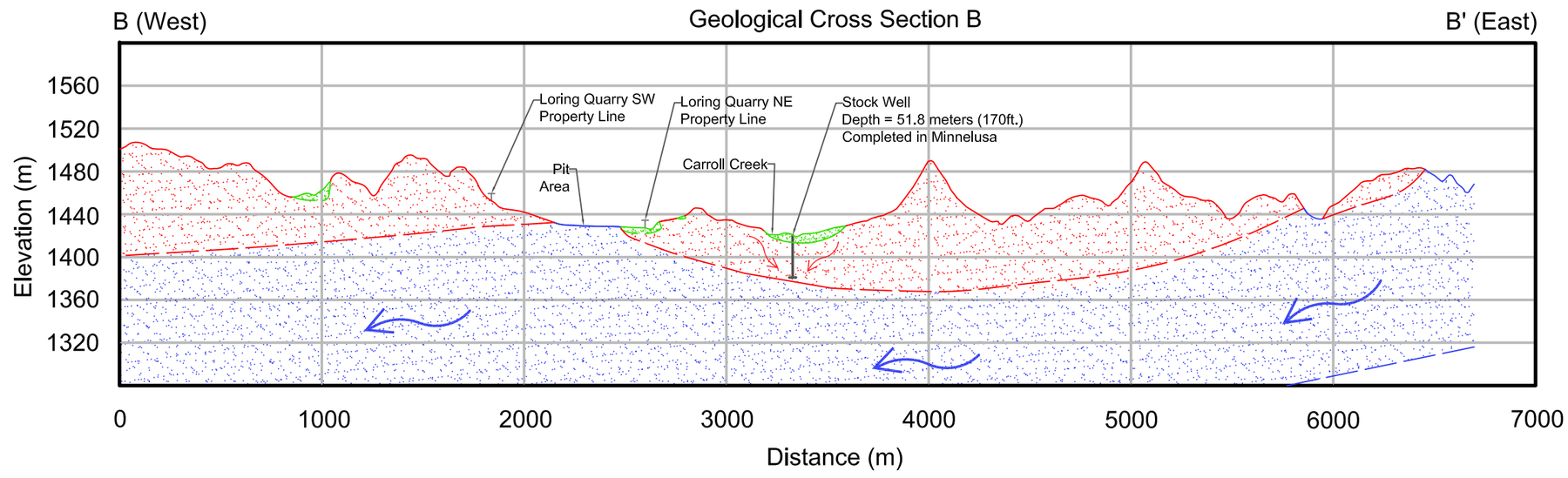
Prepared by:
Becky Morris
Senior Environmental Scientist
H2E, Inc. 4/15/2022

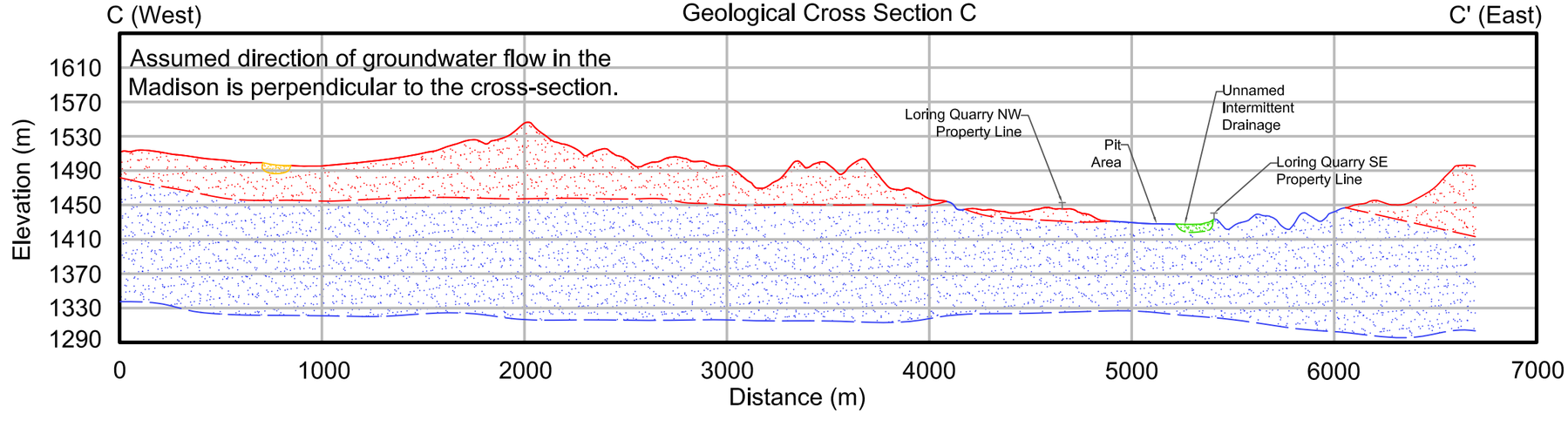
Becky Morris

Map Exerpt from Redden & DeWitt, 2008.









SIMON

Loring Quarry
Map of Viewshed for Adjacent Property
SDCL 45-6B-10
ARSD 74:29:02:03

0 0.1 0.2 0.4

Miles

N W E S

Scale: 1:9,000

Date Produced: 3/30/2022

Designed to be printed at 11" x 17"

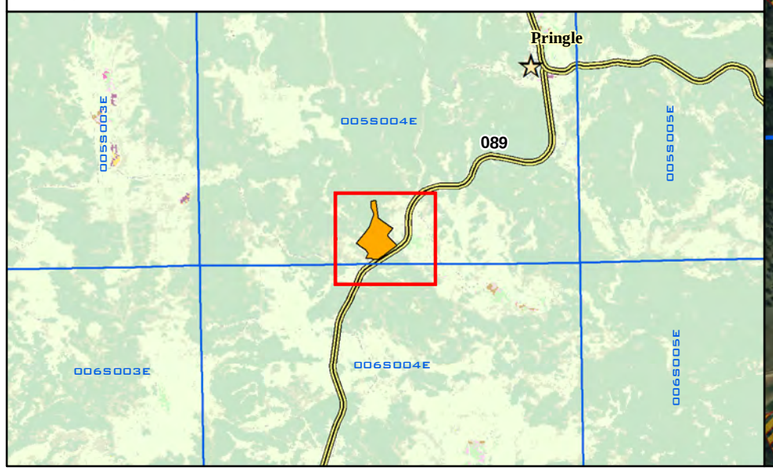
Prepared by:

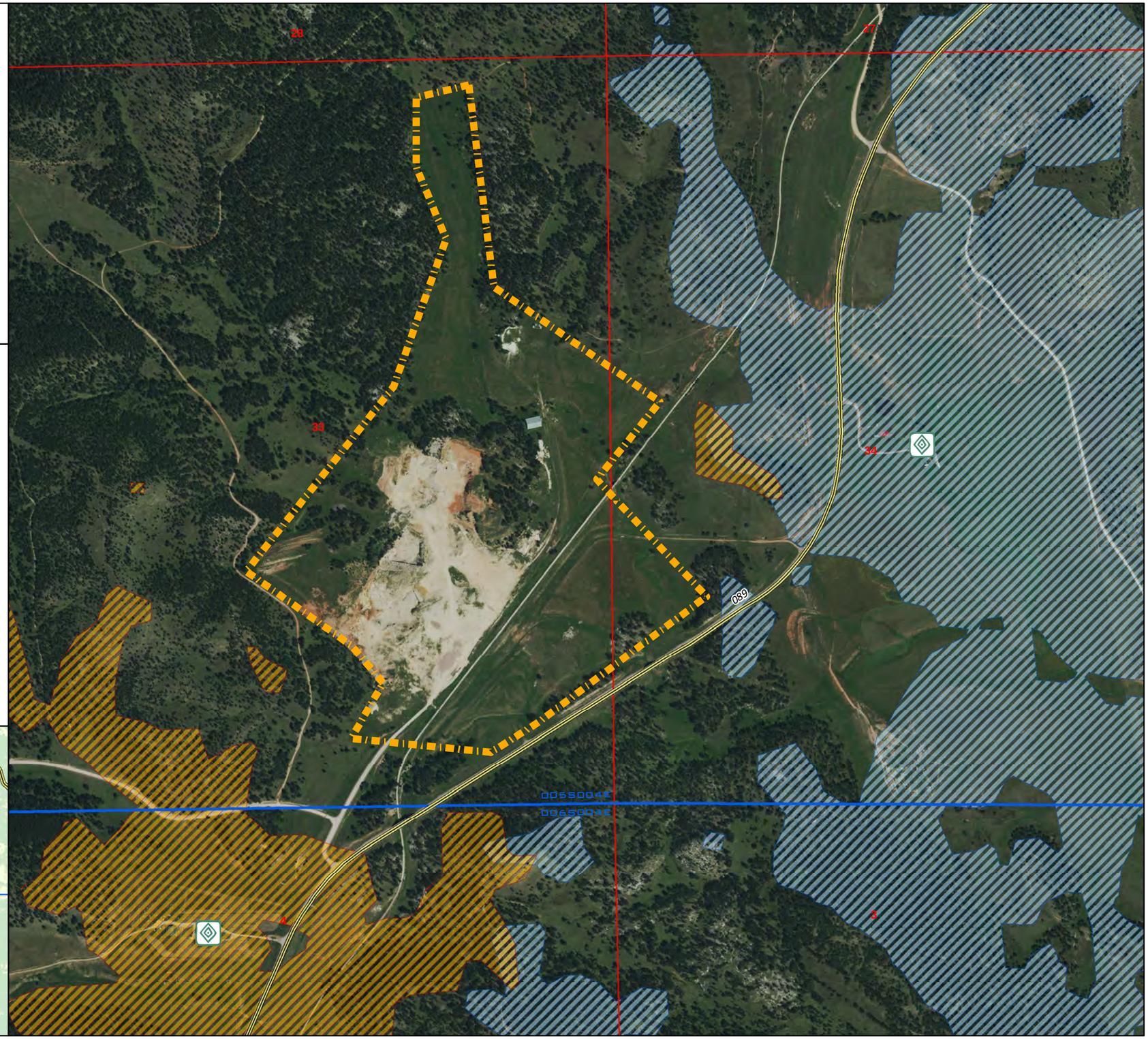
Editor: RGilson

- Residence
- SD Highways
- Viewshed Extents (Residence in Sec 4)
- Viewshed Extents (Residence in Sec 34)
- Loring Quarry Property Boundary
- SD Counties
- Township/Range
- Section

Note: Simon Contractors of SD, Inc. is the surface and mineral owner of the affected land.
Note: There are no oil and gas wells or pipelines in the area of affected land or within 200' of the affected land.
Note: Base map is a U.S. geological survey seven-and-one-half-minute quadrangle map in accordance with ARSD 74:29:02:12.
Note: Viewshed analysis utilizes ESRI prebuilt tools and uses the finest DEM data available. The results are a desktop analysis for planning purposes. Parameters: maximum distance = 1 mile; observer height = 6 ft; surface offset = 10 ft; generalize viewshed polygons = on.

Prepared By:
Robert Gilson
Environmental Professional
H2E, Inc.





Document Name: Mine_Permit_Viewshed_v2

Section IX
Technical Revisions List

Loring Quarry

Simon Contractors of SD, Inc.
Large Scale Mine Permit – Loring Quarry
Technical Revisions

Pursuant to ARSD 74:29:03:16 Simon Contractors of SD, Inc. proposes the following technical revisions:

1. Monitoring plans or parameters;
2. Seeding mixtures or rates;
3. Modification or relocation of erosion, sedimentation, or drainage control;
4. Topsoil stripping or storage;
5. Implementing new or improved reclamation techniques as they are developed;
6. Modification of dust control measures;
7. Modification of the size of area to be worked at any one time;
8. Modification of operating time tables for proposed operations;
9. Location or modification of ancillary facilities within the permit boundary, including equipment storage areas, perimeter fencing and stockpiles;
10. Modification of the reclamation plan;
11. Request excess topsoil be used for reclamation purposes elsewhere;
12. Addition of a wash plant and washing ponds to remove limestone fines from specific products to meet customer specifications;
13. Modification of the acreage split (adjusting the designated acres under the mine license and mine permit) may be necessary depending on future customer demand.
14. Adding contiguous affected land within the permit area when the total of such additions does not exceed 20 percent of the originally permitted affected land area.